Notes on *Commelina*

José A. Mari Mut

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During the second half of 2018 I studied the genus *Commelina* and published the observations in seven individual notes, which for the reader's convenience, have been brought together here. No changes have been made to the original texts.

Notes on *Commelina* 1. Flower variants of *C. erecta* in northwest Puerto Rico

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Dans les champs de l'observation le hasard ne favorise que les esprits préparés. —Louis Pasteur

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Notes on *Commelina* 1. Flower variants of *C. erecta* in northwest Puerto Rico

José A. Mari Mut

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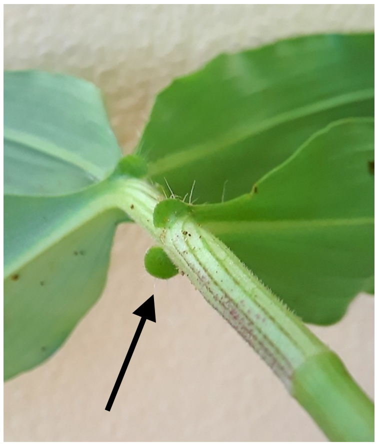
Introduction

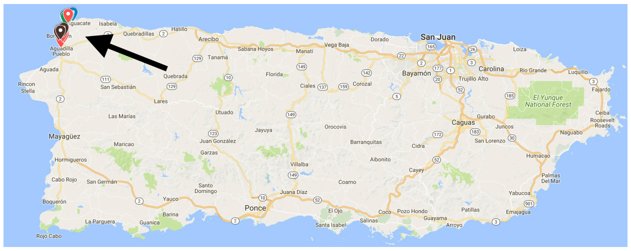
During my early morning walks along roads and streets in northwest Puerto Rico, I have observed many plants referable to *Commelina erecta* and noted that they can be segregated into four flower types, even though only one variety of the species is included in current databases and floras of the island. The purpose of this report is to bring these types to the attention of botanists better equipped to study them and decide if they are simple variants, or if perhaps other varieties or maybe even other species have been lumped locally under *C. erecta* var. *erecta*.



Commelina erecta was described by Linnaeus in 1753 from specimens collected in Virginia, USA. The species has been described under other names, and varieties have been erected based mainly on pilosity and leaf shape. As currently understood, *C. erecta* has a very wide distribution, extending from the United States through Central America to South America and the Caribbean, it has also been reported from Africa, western Asia and Australia. The species is easily distinguished from the other three members of the genus found in Puerto Rico (*C. diffusa*, *C. benghalensis* and *C. rufipes* var. *glabrata*) by the presence of two small lobes or auricles where the leaf blade meets the stem. Known in the island as *cohitre azul* and in the USA by several names, including slender dayflower and white mouth dayflower, *C. erecta* grows locally along roads, walkways and fences; around tree trunks; among other plants in gardens; and in disturbed sites from sea level to 1000 m (Axelrod 2011). Acevedo-Rodríguez and Strong's Flora of the West Indies (http://botany.si.edu/antilles/WestIndies/) provides the following synonyms for

Puerto Rico: *Commelina elegans* Kunth 1816, *Commelina erecta* L. var. *hamipila* (C. Wright ex Sauvalle) Brashier 1966, *Commelina hamipila* C. Wright ex Sauvalle 1870, and *Commelina virginica* sensu authors, non L.

Methods



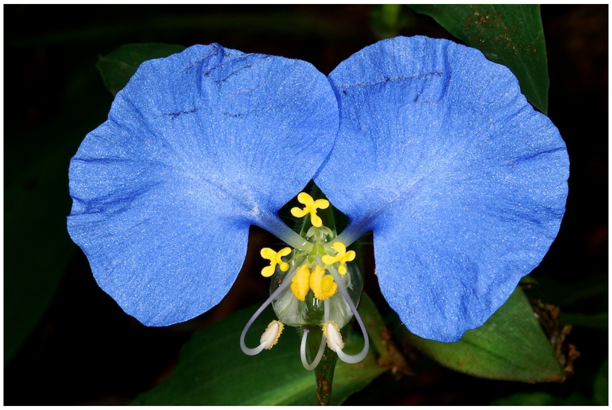
The plants were found from January to August 2018 where shown on the map (click on this link to view a large version, increase the size of the map to distinguish nearby markers). Observations were made *in situ* with a Bausch & Lomb 14x loupe, and cuttings of types 1 and 2 were grown at my garden (Rd. 467, km. 1.9; 18.4648, -67.14846) for additional observations and photography; types 3 and 4 have been present in my backyard for at least three decades. Photos were taken with a Sony a77ii camera fitted with a 50 mm macro lens; white balance was adjusted to produce accurate petal color in natural light, the flash setting was used for photos taken with a Metz macro flash. Since flower size may vary somewhat between plants growing under diverse conditions, flowers were measured in my garden on plants grown under partial shade and watered after three rainless days.

Results and Discussion

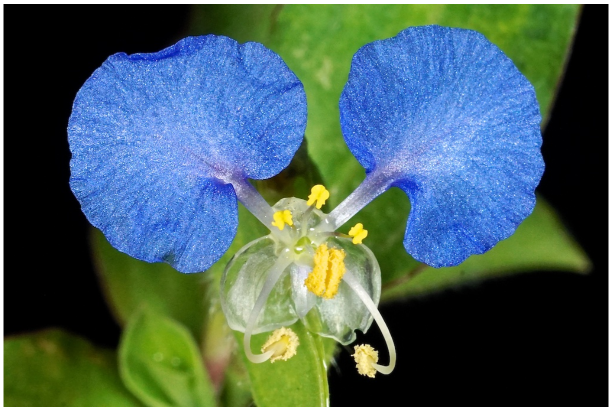
All plants produced a single type of flower. Rarely did plants of two flower types grow nearby, and on the few occasions when two types were found intermixed, the flower-bearing stems were traced to the ground and found to originate in different plants. The four flower types had similar leaves, spathes and medial petals; they also had terminal inflorescences and lacked the upper cincinnus. In other words, aside from the differences noted below, they all have the characters expected of *C. erecta* (e.g., Pellegrini and Forzza 2017).

Although it is widely accepted that *Commelina* flowers evolved for insect pollination (e.g., Hrycan and Davis 2005), I have only seen one or two honeybees and an occasional small syrphid visiting them briefly in my garden; no other insects were seen elsewhere. The little interest of pollinators for the flowers of *C. erecta* was noted by Rivero and Almodóvar

(2009) in Mayagüez (~20 miles south of Aguadilla) and by Oziegbe et al. (2013) in Nigeria. The flowers, however, readily self-pollinate and produce seeds.

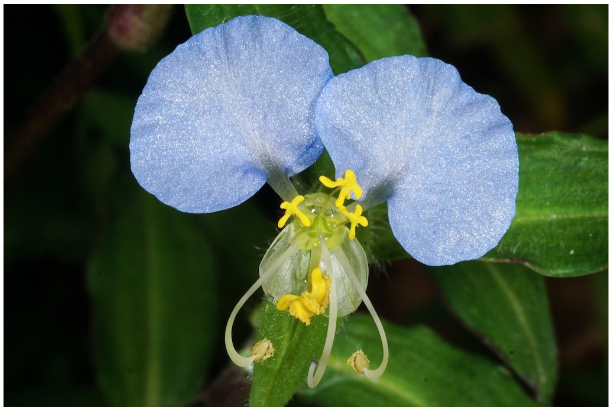


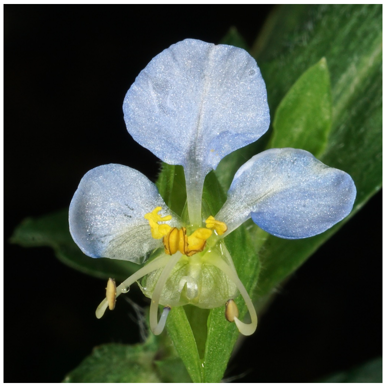
Type 1. This is the flower typically identified as *Commelina erecta,* but it may not be the one on which old Puerto Rico records of the species are based. Juan A. Rivero, a very experienced Puerto Rican naturalist, stated in Rivero and Almodovar (2009): *The main author lived a good portion of his life in the country and never saw the species until about 15 years ago when, impressed by a colorful patch at the Vocational School at Mayaguez, brought some seeds and planted them in his garden.* This flower type is very attractive due to its rich blue color, large size (~36 mm wide) and the abundance of flowers. The antherodes are X-shaped, with the lower lobes equal to or slightly longer than the upper ones.



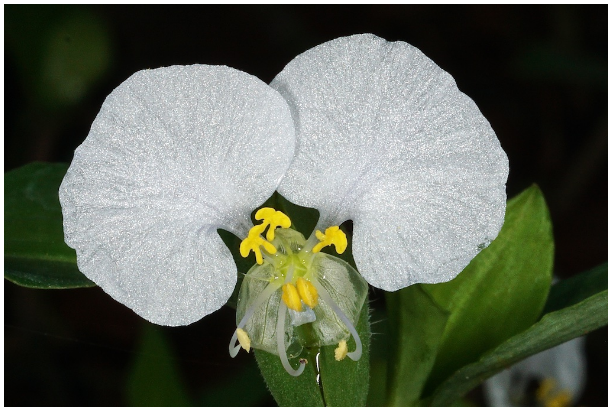
Type 2. At ~17 mm wide, this type is much smaller than the preceding but the petals are equally blue. The antherodes may be either small, with very compact lobes (as in the photo) or larger, with wider upper lobes. Further study is needed to understand the variation just noted; this flower type may consist of more than one type, or the flowers with larger antherode lobes could be a dwarf version of type 1 or a darker and smaller version of type 3. Plants of this type seem to be small, produce fewer flowers and grow more slowly than the other types.

Type 3. At ~21 mm wide, this type is considerably smaller than the first but notably larger than the second (see Plate 1). It is readily recognized by the light-blue petals, which may be slightly paler or darker in different localities without reaching the intense blue of types 1 and 2 nor the white of form 4.





The antherodes are X-shaped and the lower lobes are typically longer and thinner than the upper ones. A peculiarity of this type is that one staminode (usually the central one) quite frequently develops partially or even completely into an additional petal. Preliminary observations suggest that this type opens earlier than the others, the flowers being fully expanded when types 1 and 2 are partially open and type 4 has not begun opening; it also seems to be the fastest growing and most vigorous type, sometimes producing surprisingly large, thick stems with leaves up to 11 cm long. As the map shows, this type had the widest distribution; it may be the flower recorded from the island by synonyms of *C. erecta* (see last sentence of the introduction), as well as the *C. erecta* with light-blue petals studied in Nigeria by Oziegbe et al. (2012).



Type 4. At ~22 mm wide, this white type is similar in size to the preceding one or slightly larger. The upper lobes of the antherodes are thicker and extend laterally, giving the antherodes the appearance of minute body builders or two-tailed kites. The plant seems to grow slower than the preceding type and produces fewer flowers. Rivero and Vives (2013) illustrated this flower and in noting the differences between it and type 1 commented: *Although considered a variety of C. erecta, it differs from that species in the white color and smaller size of the flower, in the morphology of its staminoids, and in maintaining its identity when growing together with C. erecta, which probably justifies it as a different species.* This flower was called *Commelina erecta* var. *erecta* f. *alba* Magrath 1971 by Mari Mut and Vives (2018).

Since *Commelina erecta* is considered a very variable species, it is tempting to dismiss the four flower types noted herein as simple variation. Although this could be correct, it seems to me that they deserve additional study, if not because they may belong to other species or varieties, at least to understand their origin, persistence and potential adaptive value. The study of flowers from nearby and distant locations, the study of herbarium specimens, comparisons of additional characters, cross-breeding trials, and perhaps genetic analyses should settle the status of *C. erecta* in Puerto Rico.

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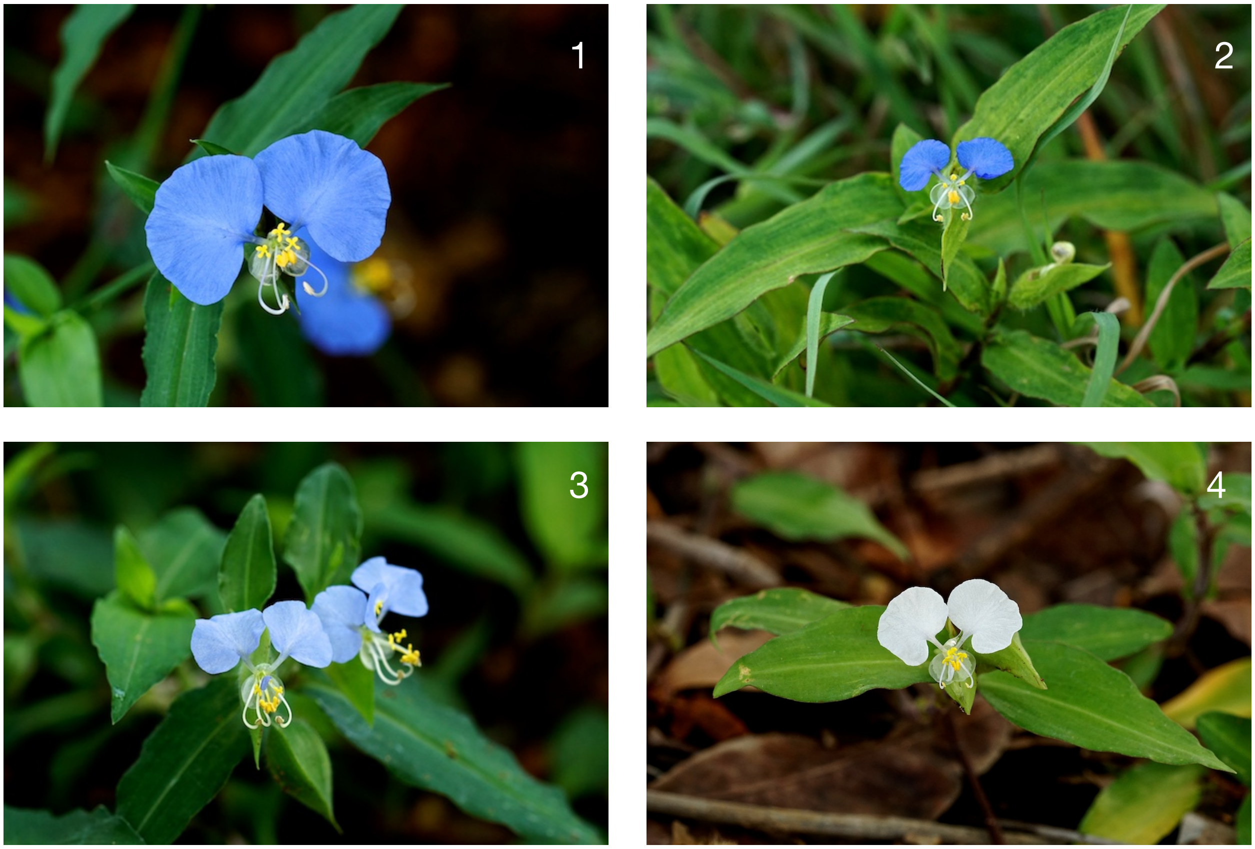
misc/Rivero&Almodovar.pdf and at https://archive.org/details/RiveroandAlmodovar

Rivero, J. A. and M. A. Vives. 2013. Flores silvestres de Puerto Rico (Wild Flowers of Puerto Rico). Ediciones Puerto, San Juan. 389 pp.

Plate 1. The four flower types in natural light and at identical magnification (1:4 on the macro lens) to illustrate size differences.



Notes on *Commelina* 2. Spathes, capsules and seeds of four *C. erecta* flower types in Puerto Rico

José A. Mari Mut

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For Dr. Juan A. Rivero (1923-2014), eminent Puerto Rican naturalist, who would have been thrilled by the seed photographs presented here. On the cover- Type 3 flower. Photograph by the author.

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URLs- http://edicionesdigitales.info/commelina/seeds.pdf, https://archive.org/details/seeds_201809. Updated November 6, 2018.

Notes on *Commelina* 2. Spathes, capsules and seeds of four *C. erecta* flower types in Puerto Rico

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Introduction

The first note of this series (Mari Mut, 2018) described briefly four flower variants or types of *Commelina erecta* observed during early morning walks in northwest Puerto Rico; it also commented that the study of additional characters could shed light on their taxonomic status. This study compares spathe size, number of capsules per spathe, capsule ornamentation and seed morphology.

Methods

Spathes containing only capsules were collected from plants of each flower type. Spathe length and height were measured to the nearest millimeter with a metal ruler. Spathes were then opened, the capsules observed with a 14x Bausch and Lomb loupe, and their number tallied. Seeds were collected from other spathes which had capsules ready to release seeds; such spathes typically face downwards, tend to be lighter green or yellowish, frequently are partly open, and are dry (contain no viscous water).

Spathes and capsules were photographed with a Sony a77ii camera equipped with a Sony 50 mm macro lens and a Metz macro flash. Capsules were photographed at the lens' maximum magnification (1:1). Twenty seeds of type 1, 13 of type 2, 24 of type 3, and 14 of type 4 flowers were examined with an Olympus stereoscopic microscope. Two seeds of each flower type were photographed with an Infinity K2/SC long-distance microscope with 3:1 magnification, connected to a Canon 7D camera tethered to a computer running focus-stacking software. A 2 mm scale added to the seed photographs was used to measure seed length. The type 2 plants used for this study are of the kind that produce flowers with small and compact staminodes.

Results and Discussion

Spathe size and number of capsules- Spathes of the four flower types are similar in shape (Plate 1). Plants with type 1 flowers produced the smallest spathes (~13.6 mm long x 12.8 mm high, n=10) and had an average of 2.0 capsules per spathe. Plants with type 2 flowers produced longer and lower spathes (~15.5 x 10.4 mm, n=11) and had an average of 2.2 capsules per spathe. Plants with type 3 flowers produced larger spathes (~17.7 x 14.7 mm, n=16) and had 2.1 capsules per spathe. Plants with type 4 flowers produced slightly larger spathes (18.1 x 14.5 mm, n=13) and had 3.5 capsules per spathe (5 being the highest number).

Capsule ornamentation- Capsules of the four flower types are trilocular (rarely bilocular), with the anterior pair of locules dehiscent and the posterior locule indehiscent. All the seeds studied came from dehiscent locules. The walls of the anterior locules are smooth while those of the posterior locule have warts which are most prominent in capsules produced by type 2 flowers and least so in capsules produced by type 4 flowers, with types 1 and 3 being intermediate (Plate 2).

Seed morphology and size- Seeds produced by type 1 flowers differ from the others by having a conspicuous keel, lip or ridge which is interrupted in front of the embryotega (Plate 3). Seeds of type 2 flowers are prominently reniform, lighter in color and have two broad whitish bands; at 2.7 mm long, they are also distinctly smaller than seeds of the other types (1- 3.6 mm, 3- 3.5 mm, 4- 3.4 mm). Seeds of type 3 and type 4 flowers are most similar, both being dark brown and less reniform.

Capsules and seeds are important in the taxonomy of *Commelina*; for example, Faden (1993) lists the testa of the seed as the most absolute character distinguishing *C. caroliniana* (testa reticulate) from *C. diffusa* (testa smooth); seeds of the former are also larger and darker. Joseph and Nampy (2012) found signifiant differences between the capsules and seeds of the 18 species of *Commelina* present in southern India; the differences were so important that they prepared a key to the species using only capsule and seed characters.

The differences in spathes, capsules and seeds (compare particularly Plate 3, figures 1 and 2), along with those in flower color, flower size and staminode morphology presented in the first note of this series, lend support to the notion, first proposed by Rivero and Vives (2013), that plants called *C. erecta* in Puerto Rico belong to more than one species.

Acknowledgments- José R. Almodóvar, Department of Biology, University of Puerto Rico at Mayagüez, provided access to the stereoscopic microscope and took the photographs of the seeds. The other photographs were taken by the author.

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Rivero, J. A. and M. A. Vives. 2013. Flores silvestres de Puerto Rico (Wild Flowers of Puerto Rico). Ediciones Puerto, San Juan. 389 pp.

Plate 1. Spathes of the four flower types, photographed at the same magnification. 1- large blue flowers (typical *C. erecta*), 2- small blue flowers, 3- light-blue flowers, 4- white flowers.

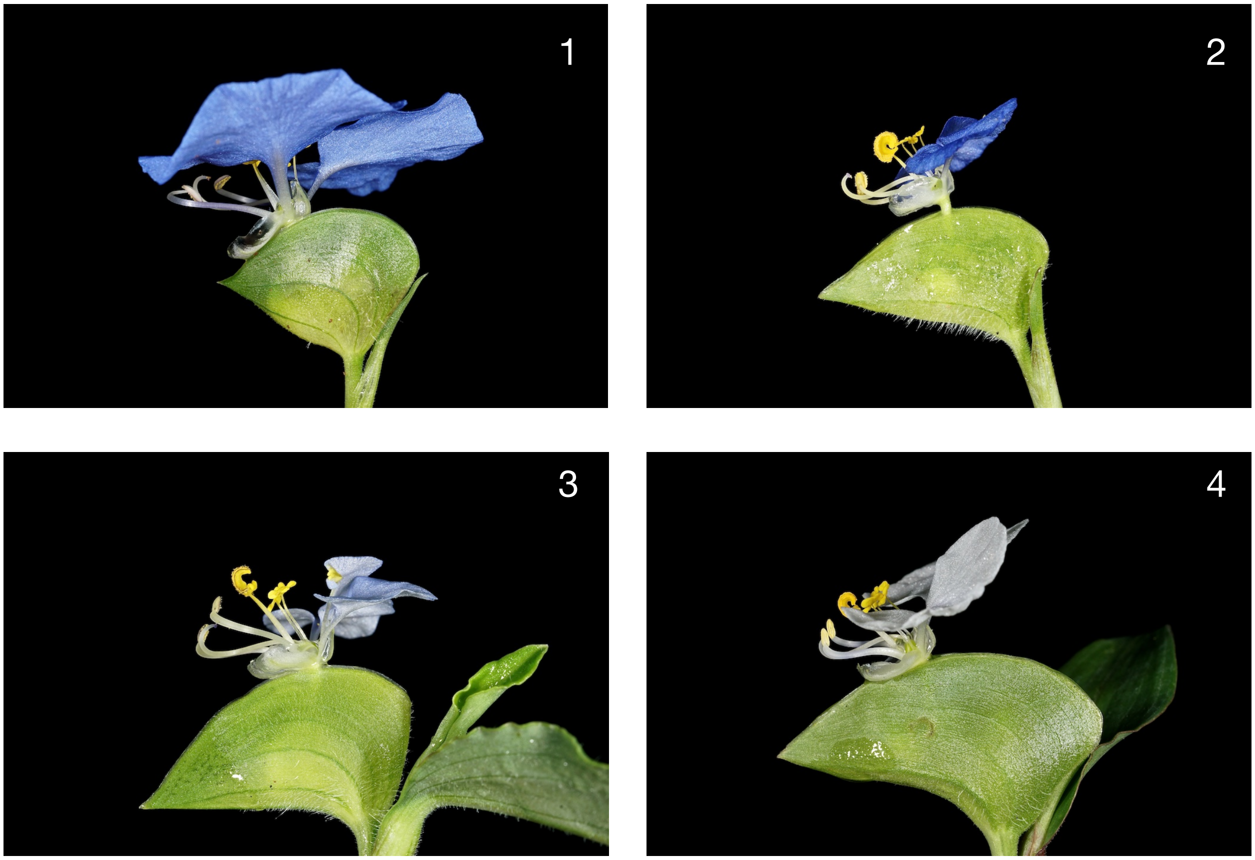
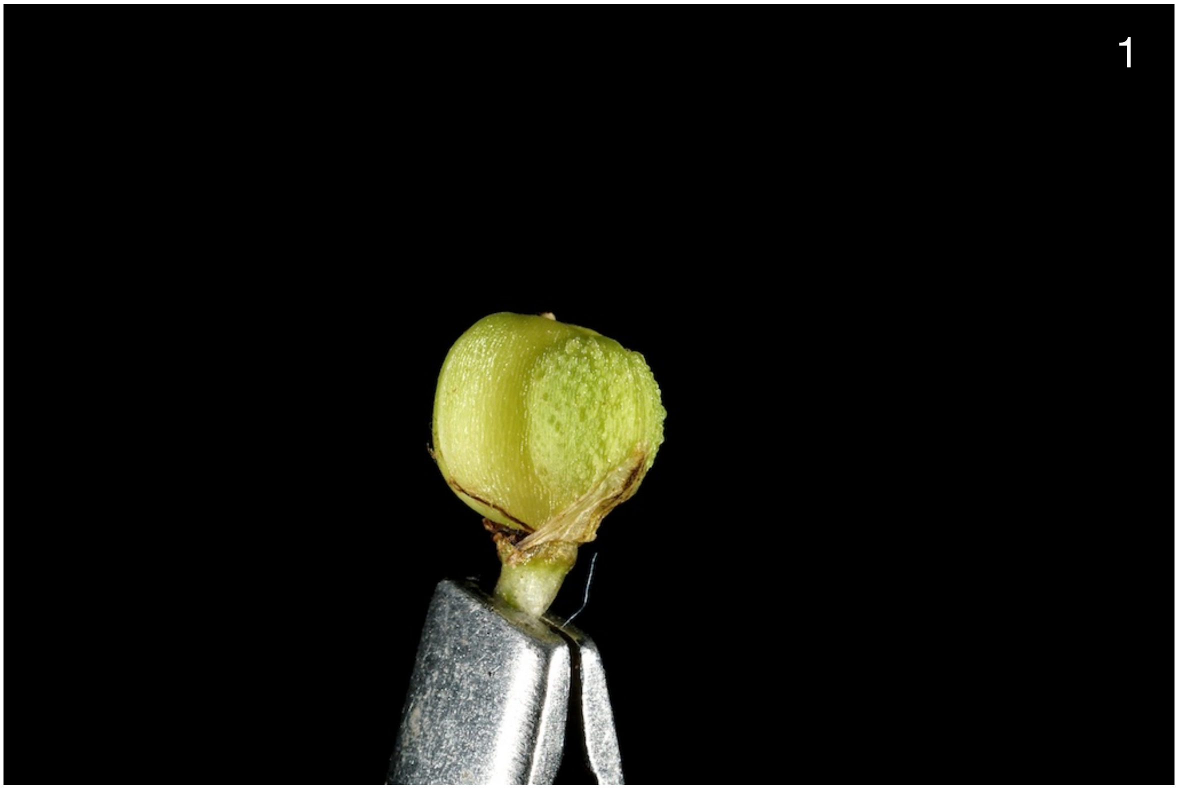


Plate 2. Capsules of the four flower types, photographed at the same magnification. 1- large blue flowers (typical *C. erecta*), 2- small blue flowers, 3- light-blue flowers, 4- white flowers.



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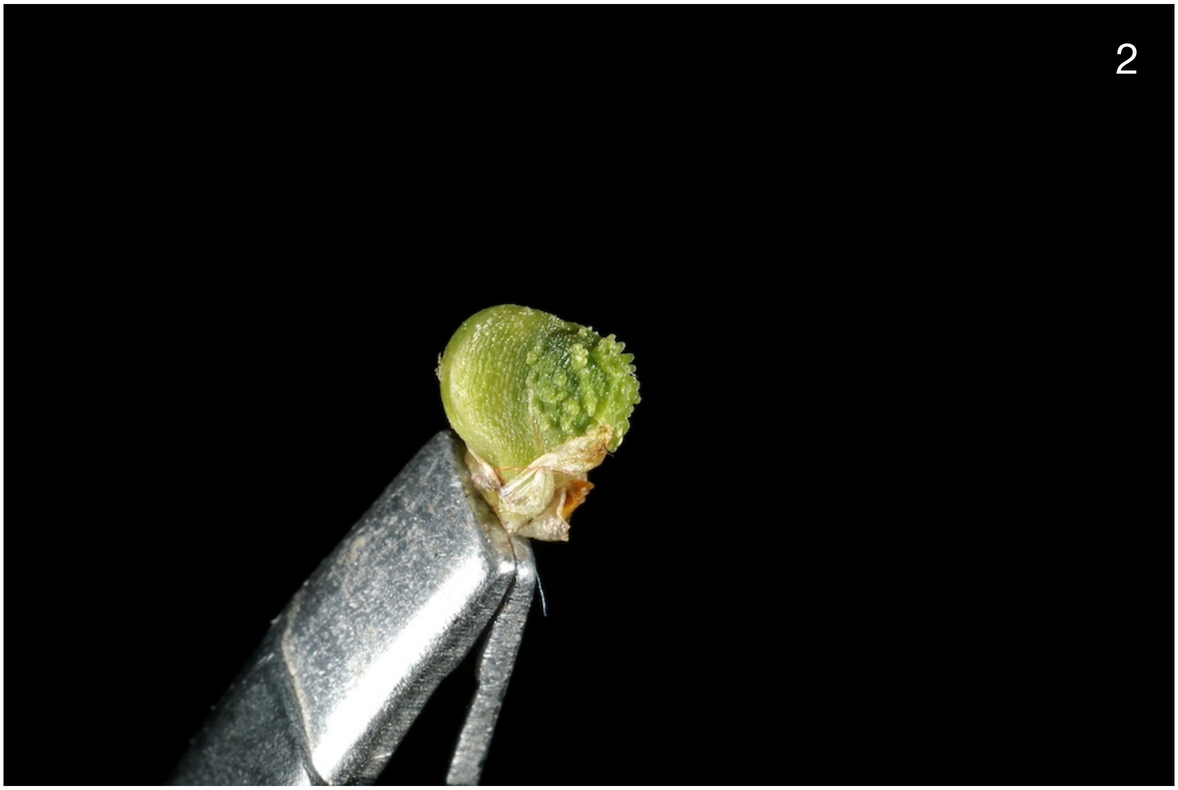

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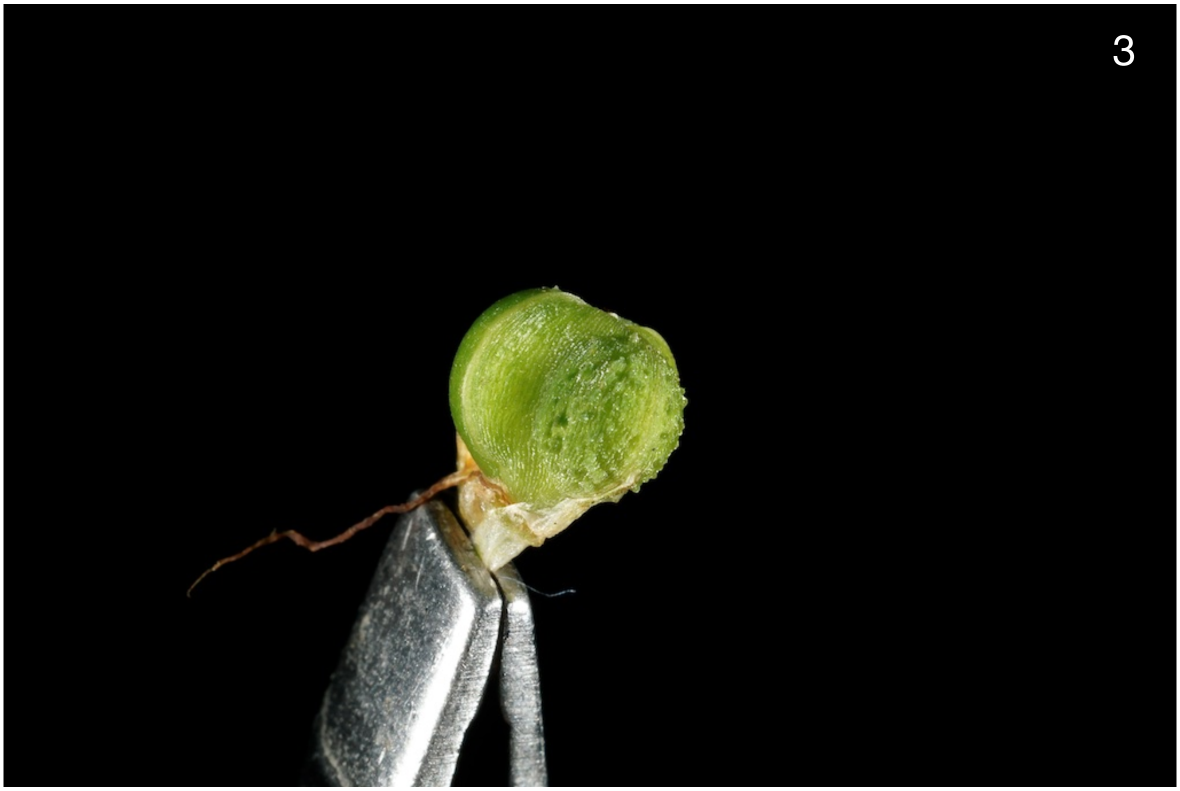
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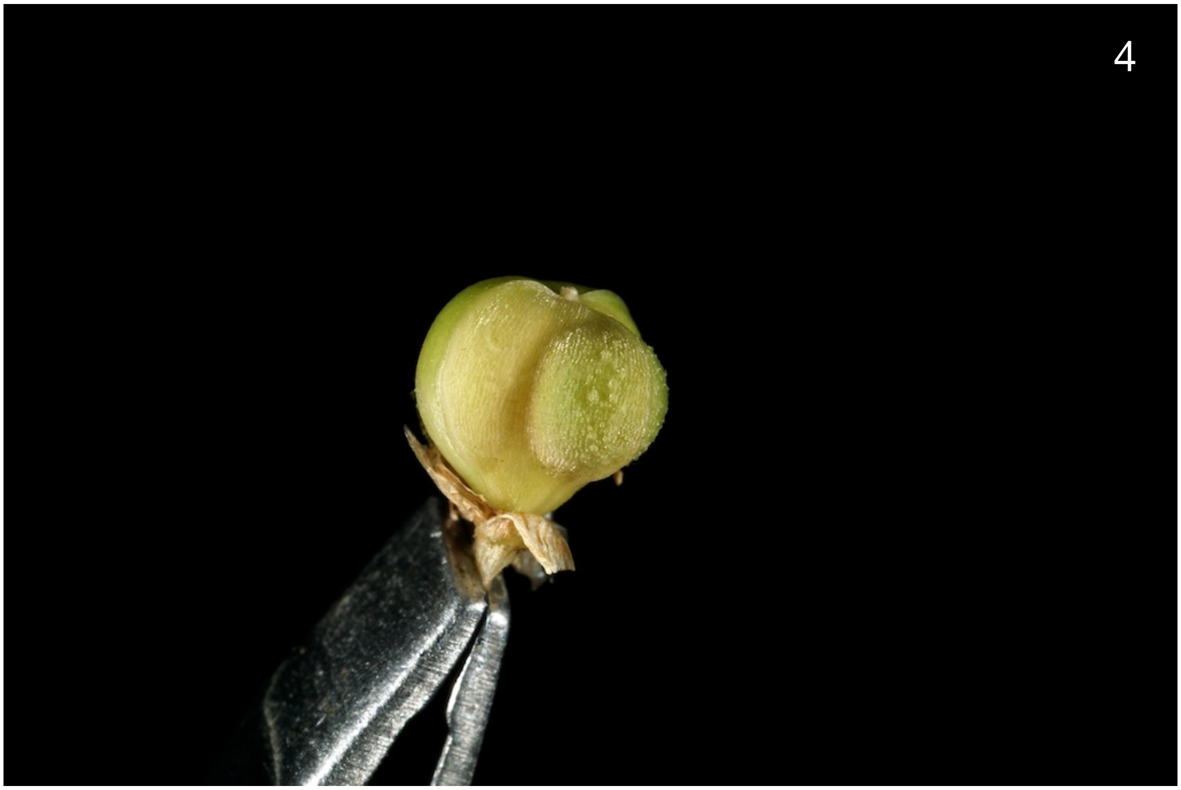
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Plate 3. Seeds of the four flower types, photographed at the same magnification. 1- large blue flowers (typical *C. erecta*), 2- small blue flowers, 3- light-blue flowers, 4- white flowers.

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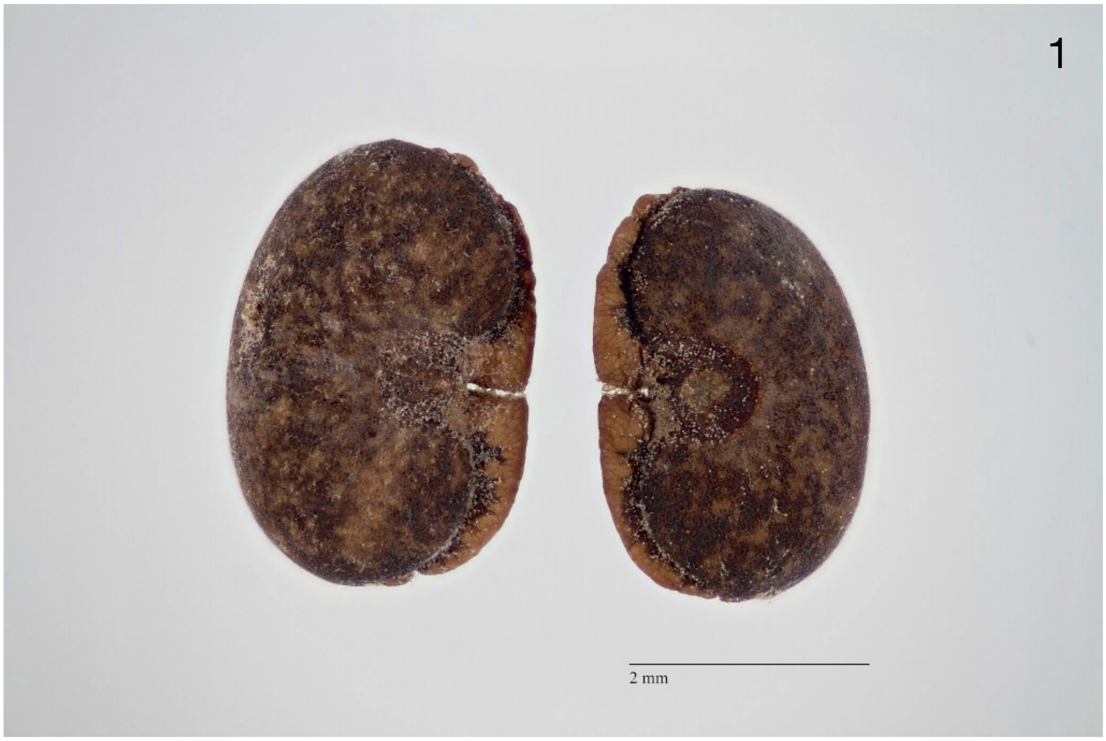

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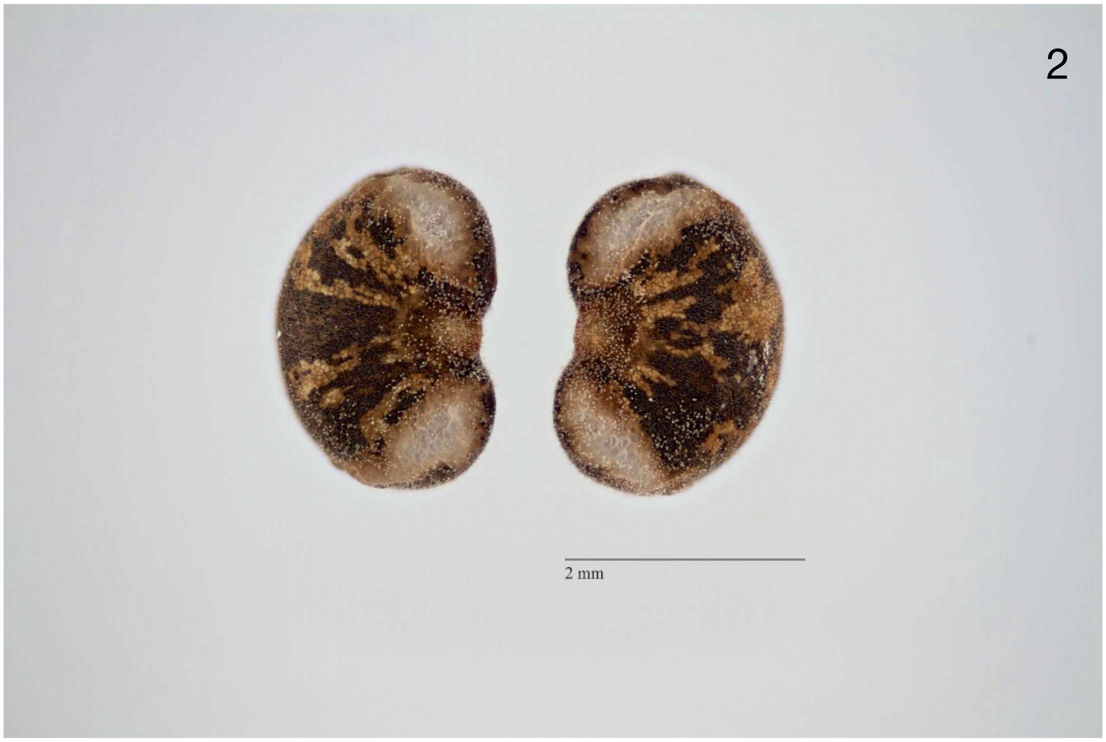

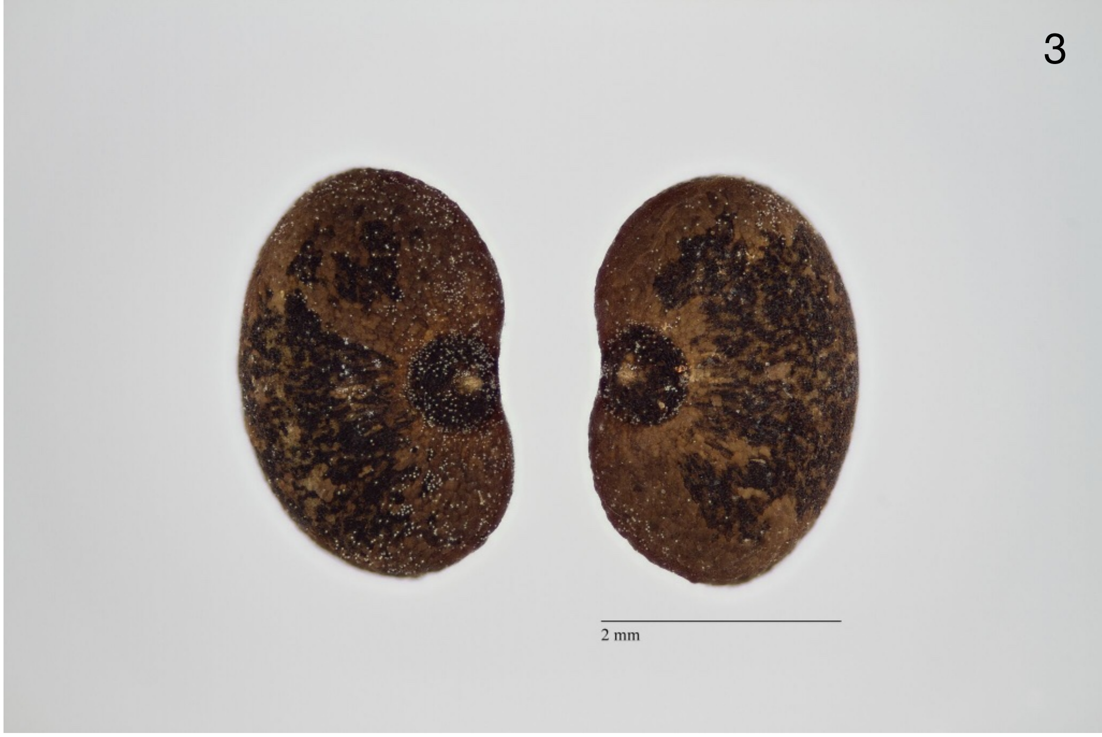
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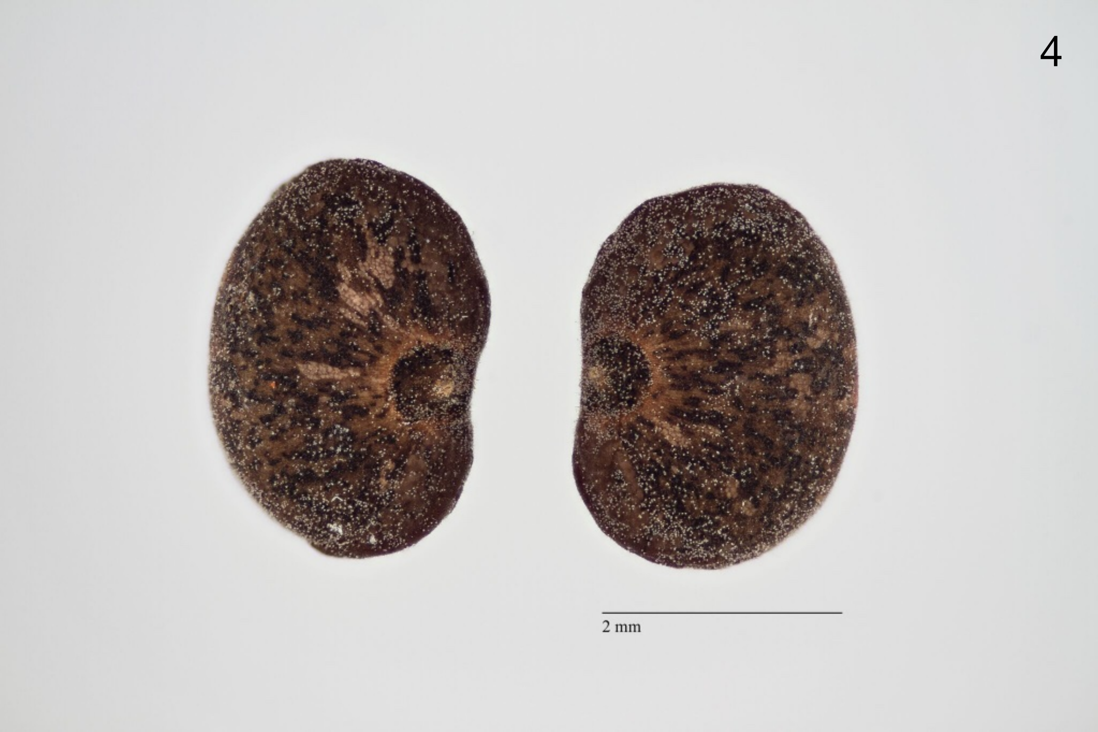
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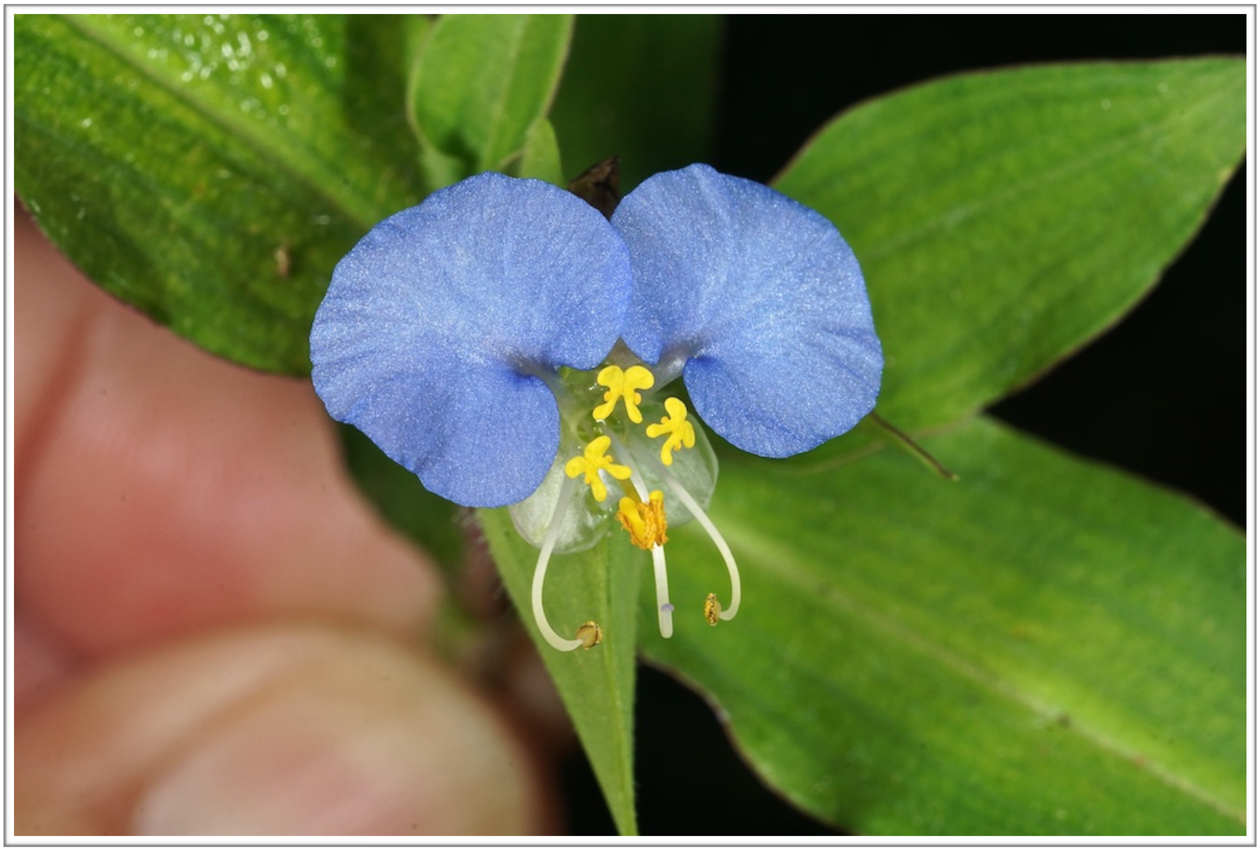
Notes on *Commelina* 3. An apparently sterile flower subtype of *C. erecta* in Puerto Rico

José A. Mari Mut



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On the cover- subtype 2b flower held and photographed by the author.

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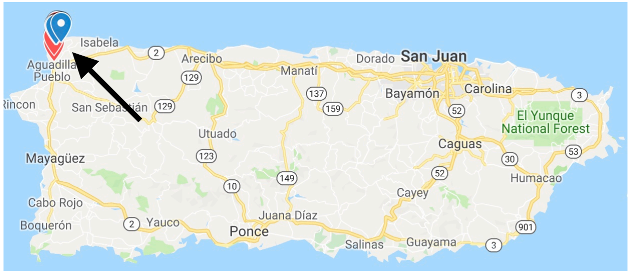
Introduction

In the first note of this series (Mari Mut 2018a), I wrote that the antherodes of *Commelina erecta* type 2 flowers could be "either small, with very compact lobes… or larger, with wider upper lobes." The purpose of the current study was to determine if additional characters could further distinguish both flower types, especially information from the spathes, capsules and seeds, studied for my second note (Mari Mut 2018b).

Methods



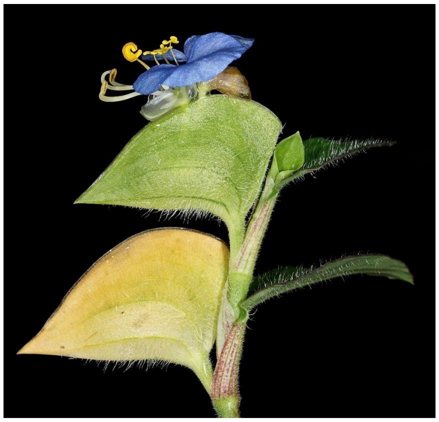
Plants of both subtypes, herein 2a (smaller antherodes) and 2b (larger antherodes) were studied during mid-September 2018 at the localities indicated on the map (click this link to view a large version, increase the size of the map to separate nearby markers). Flowers were measured to the nearest millimeter with a metal ruler, they were examined with a 14x Bausch and Lomb loupe, and photographed with a Sony a77ii camera equipped with a 50 mm macro lens and a Metz macro flash.

Results and Discussion

Flower and staminode size- subtype 2b flowers were larger: ~19.3 mm across both petals vs. 16.8 mm in subtype 2a (n=12). Subtype 2a staminodes were smaller and more compact than those of subtype 2b, which had broader upper lobes and longer lower lobes (Plate 1); the difference is small but noticeable at plain sight after becoming familiar with both flowers.

Spathe size- subtype 2b spathes were slightly larger (~16.2 mm long x 12.7 mm high, n=12) than subtype 2a ones (~15.5 x 10.4 mm, n=11, data from Mari Mut 2018a).

Capsules and seeds- described in Mari Mut (2018b) for subtype 2a, capsules (and thus seeds) were absent in all subtype 2b plants, determined by feeling the spathes for the lumps produced by developing capsules, and by opening them, which only revealed remains of failed inflorescences. It was quite surprising to find healthy plants growing and flowering but setting no fruit, their spathes wilting (yellowing) after the last flower closed.



Umoh et al. (1991) studied in Nigeria a population of *C. erecta* ssp. *maritima* that was sterile due to the production of infertile pollen. Oziegbe et al. (2013) reported similar observations, also in Nigeria, for a population *C. diffusa* ssp. *aquatica*. I have found no fruits in four flowering *C. diffusa* observed in northwest Puerto Rico. How such plants reach new locations is unknown, perhaps seeds are produced occasionally or disturbances such as strong winds and hurricanes break plants and carry fragments to places where they settle; fragmentation is commonly used to establish new *Commelina* plants for study and also for sale.

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Mari Mut, J. A. 2018a. Notes on *Commelina* 1. Flower variants of *C. erecta* in northwest Puerto Rico. http://edicionesdigitales.info/commelina/flowertypes.pdf

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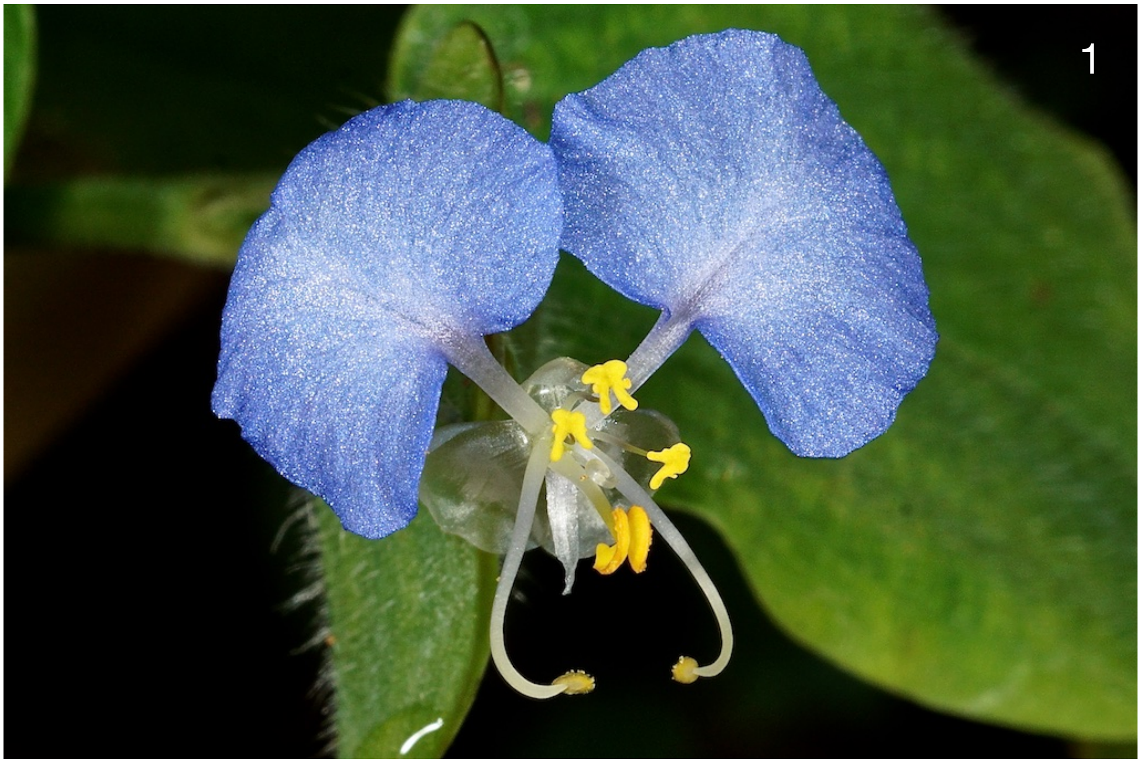
Plate 1. Flowers of both subtypes, photographed at the same magnification. 1- subtype 2a. 2- subtype 2b.



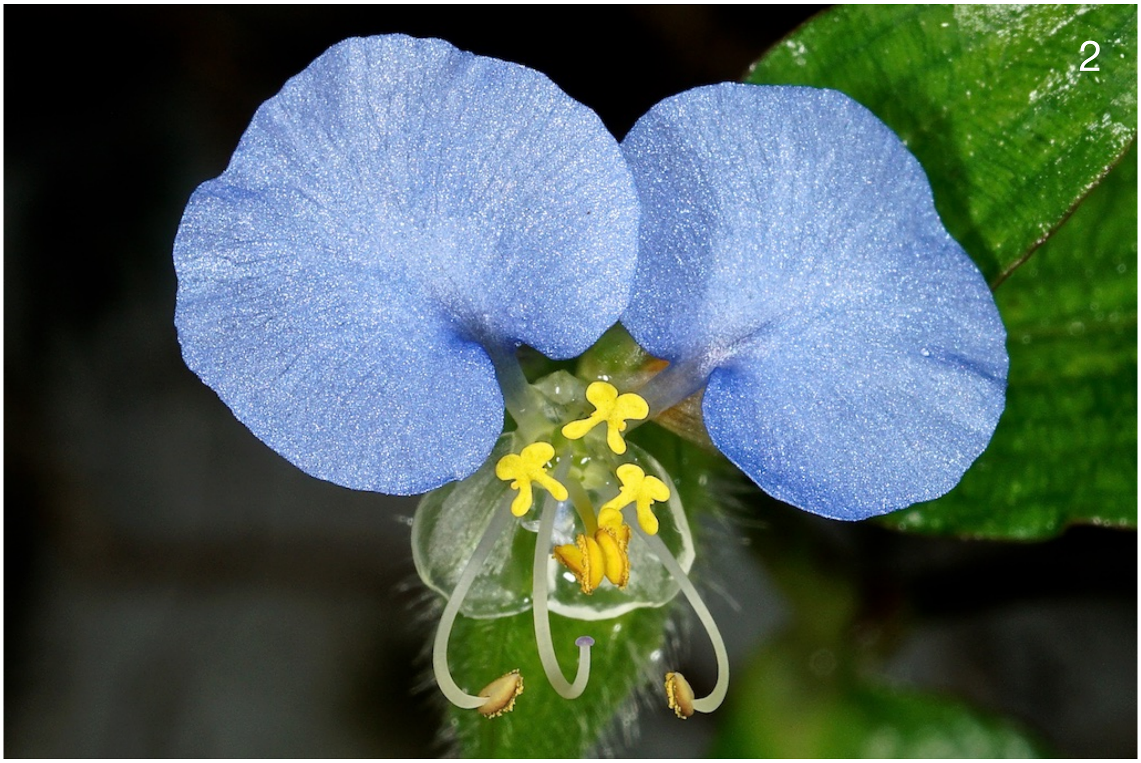
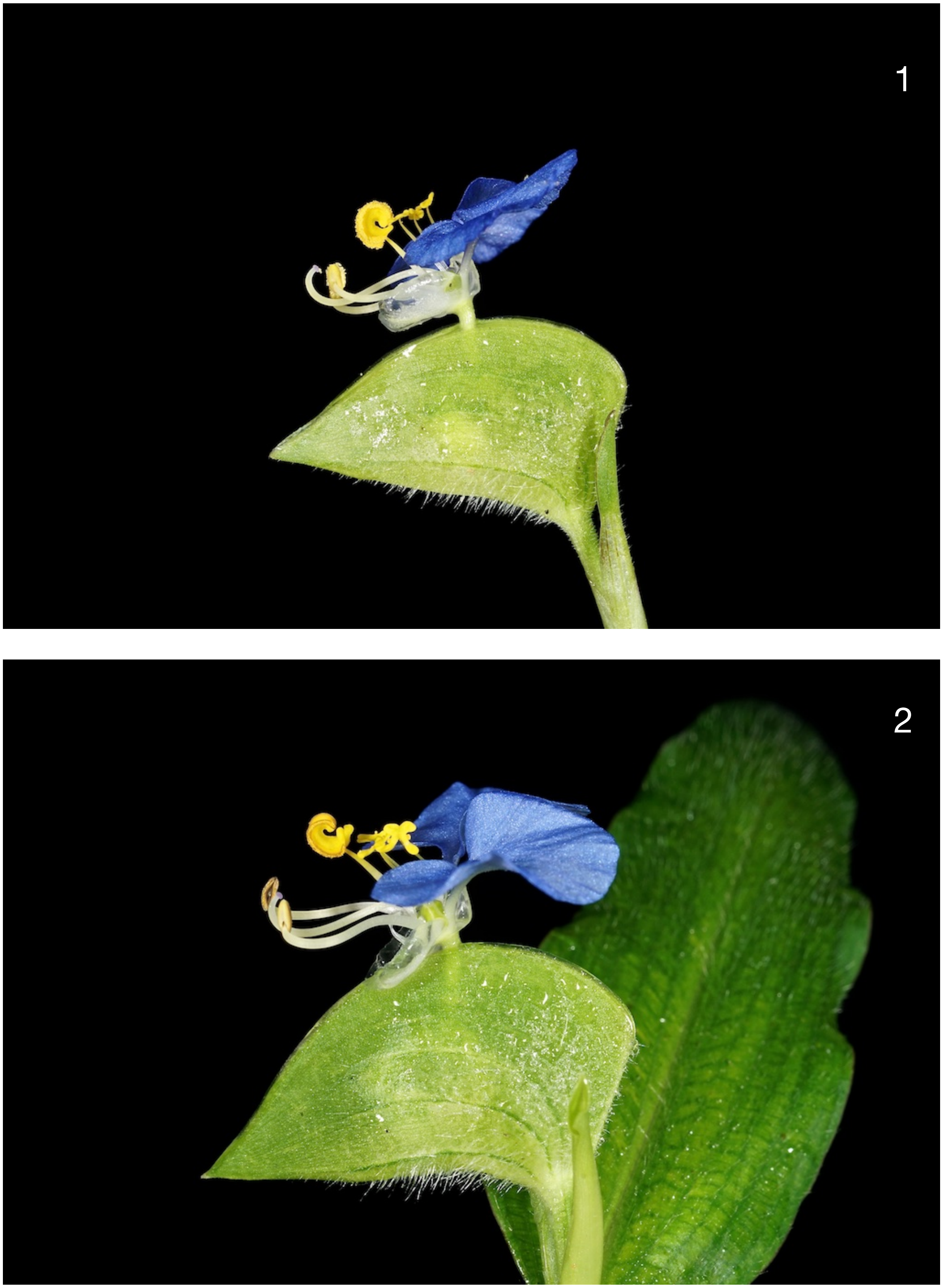


Plate 2. Spathes of both subtypes, photographed at the same magnification. 1- subtype 2a. 2- subtype 2b.



Notes on *Commelina* 4. Resurgence of a vestigial structure in a *C. erecta* inflorescence

José A. Mari Mut

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On the cover- subtype 2a inflorescence with spathe bract removed to reveal a fully developed upper cincinnus. All photographs by the author.

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Notes on *Commelina* 4. Resurgence of a vestigial structure in a *C. erecta* inflorescence

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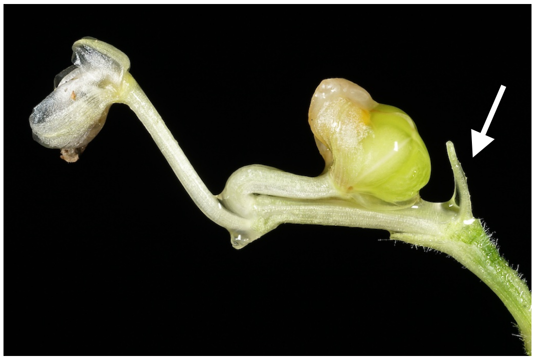
Recent treatments of *Commelina erecta* L. include among its characters the absence or reduction of the first branch of the inflorescence. For example, Flora of North America states "distal cyme vestigial, included" to indicate that the vestige of the distal cyme does not project outside the spathe. Pellegrini and Forzza (2017) included among "the only morphological characters, constant in all areas and environmental conditions" for plants in the state of Rio de Janeiro, "aborted upper cincinnus (generally completely absent, but sometimes only vestigial)…" and in the key to the species state: "upper cincinnus aborted, included."



During my studies of *Commelina erecta* in northwest Puerto Rico (Mari Mut 2018a-c), I have observed many spathes of the four flower types and had always found either no trace of the upper cincinnus or a stub too short to reach the edge of the spathe (see arrow). However, I recently found at the former Ramey Air Force base (18.49737, -67.13276) a type 2a plant with an inflorescence featuring a fully developed upper cincinnus which, as expected for other species of the genus, had a male flower (cover and Plate 1). The plant's other inflorescences were normal.

The unusual inflorescence may be considered an anomaly with no taxonomic importance, but it confirms that the stub found in the usual inflorescences is the vestige of a former fully functional upper cincinnus, and that at least some *C. erecta* plants have the genetic information needed to express an otherwise vanished structure.

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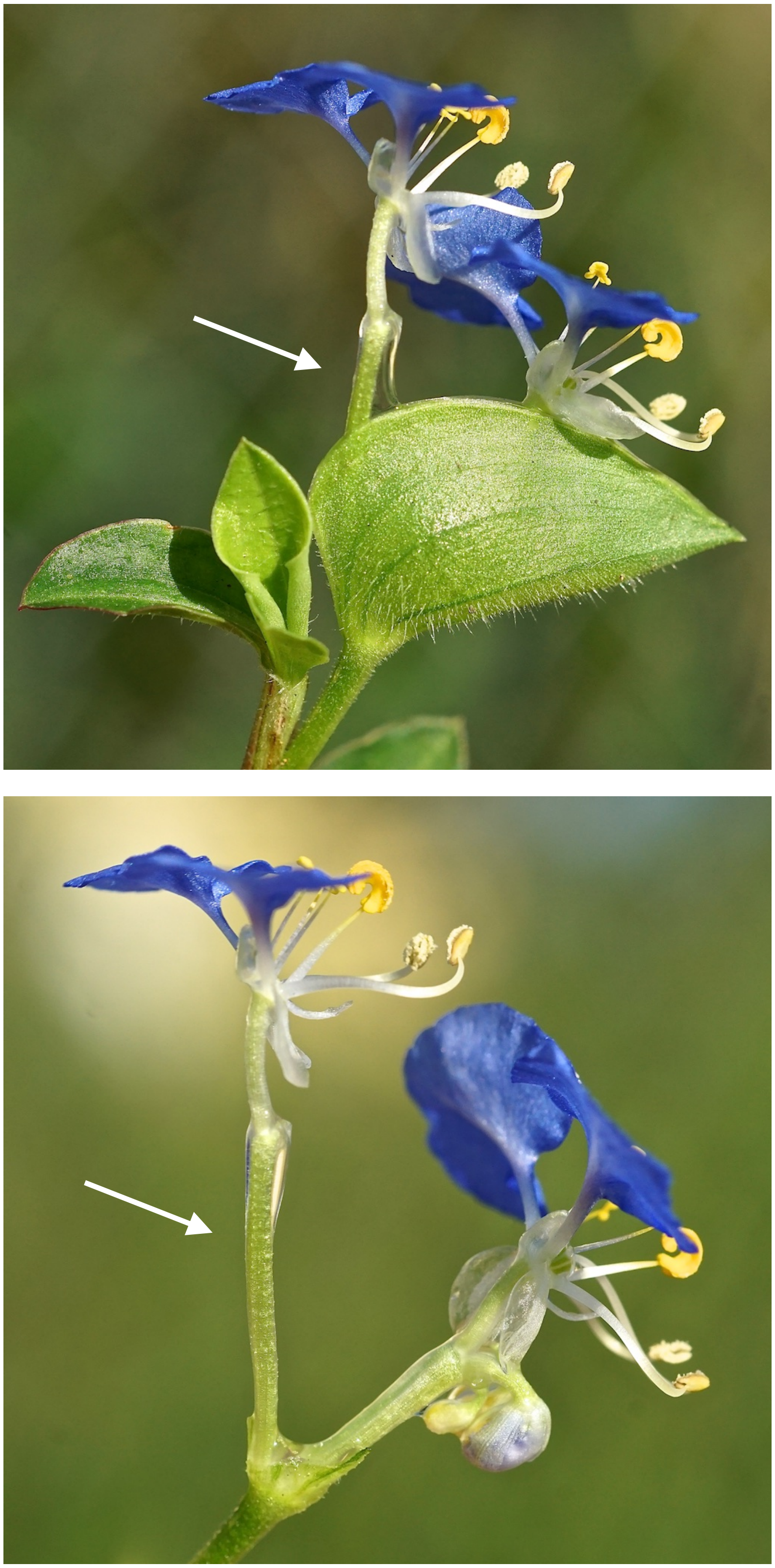
Plate 1. Flower subtype 2a inflorescence with a fully developed upper cincinnus (arrows) bearing a male flower.



Notes on *Commelina* 5. White flowers in three blue-flowered species under cultivation

José A. Mari Mut

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On the cover- *Commelina diffusa* white flower, all photos by the author.

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Notes on *Commelina* 5. White flowers in three blue-flowered species under cultivation

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During my studies of the genus *Commelina*, I have observed in the field several plants of *C. diffusa* Willd. ex Kunth and many of *C. erecta* L., all producing their usual blue flowers. This contribution reports on the appearance of white flowers in both species, and in *C. communis* L., all under cultivation at my garden in Aguadilla (18.4648, -67.14846). Blue color in *C. communis* and presumably in the other members of the genus is due to the a metalloanthocyanin pigment called commelinin (Kondo et al., 1991).

The first white flower, seen in late June 2018, was produced by a *C. erecta* type 2a plant (Mari Mutt, 2018a), this being its first flower since growing from a cutting collected about two weeks earlier. A day later the plant produced a pale blue flower and since then it has produced only blue flowers. Perhaps the different soil stressed the plant, causing it to produce the pale flowers, although two other cuttings taken simultaneously have produced only blue flowers.

The second white flower was seen in mid-July in a nearby *C. erecta* type 1 plant (Mari Mut, 2018b) which produced no more white flowers until August 27, when it produced one white flower and on the next day a very pale blue one (Plate 1). On September 3, a nearby *C. erecta* type 3 plant produced two white flowers (Plate 2). Both plants were growing normally and neither has produced additional white flowers.

White flowers were observed again on September 4, about 35 m from the preceding plants, this time on four small plants of *C. communis*, several of *C. erecta* type 3, and a large group of *C.* diffusa; the last two species were growing about 2 m apart, while *C. diffusa* was some 10 m from them. Yellowing of the *C. communis* and *C. diffusa* plants was noted shortly thereafter, suggesting that white flower production was caused by an environmental factor, possibly glyphosate overspray from an application made several days earlier to kill nearby grasses. By the end of the month, *C. communis* and *C. erecta* had recovered and were again producing colored flowers, while *C. diffusa* was still yellowish and not flowering. *Commelina benghalensis* L., a naturalized species also under cultivation in my garden, has produced only blue flowers.

Aside from white flowers being somewhat smaller, no other changes besides color were noted. *Commelina erecta* type 4 plants, which only produce white flowers, can be distinguished from the occasional white flowers of other types by examining the staminodes.

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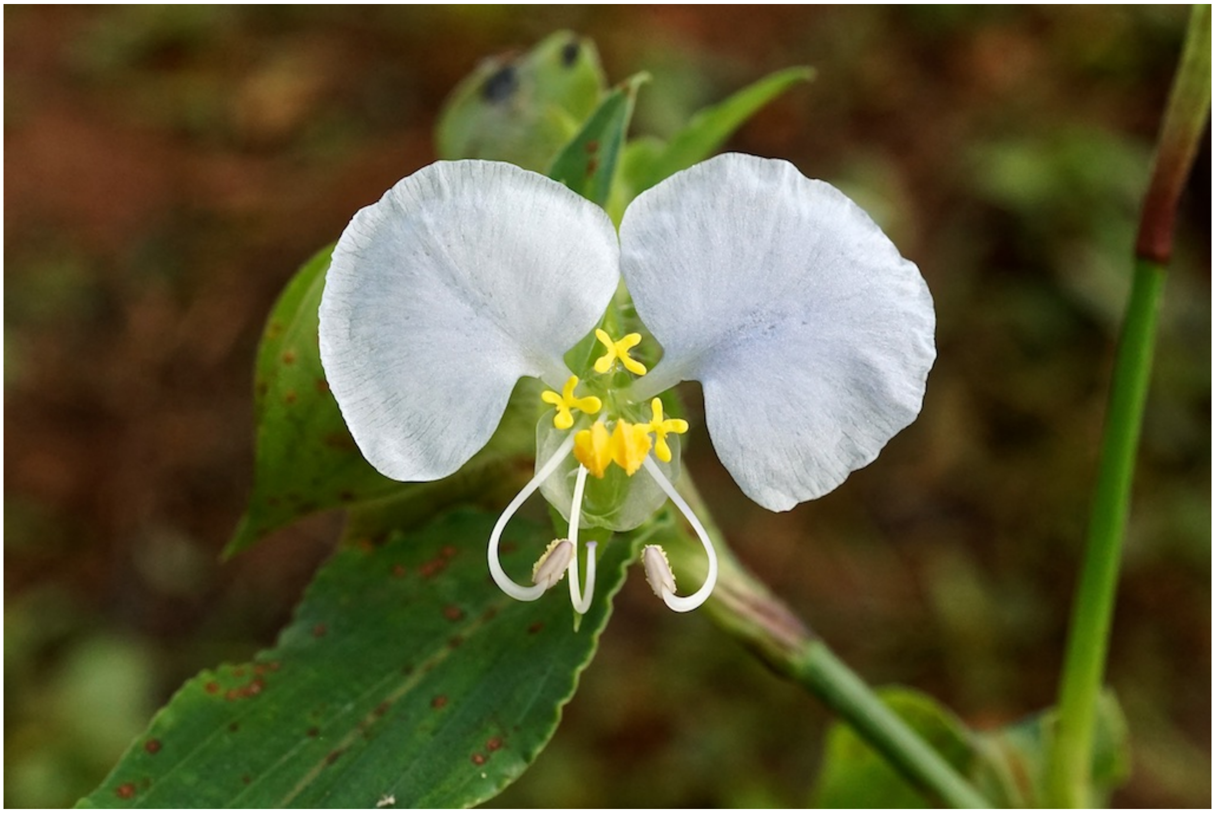
Mari Mut, J. A. 2018b. Notes on *Commelina* 1. Flower variants of *C. erecta* in northwest Puerto Rico. http://edicionesdigitales.info/commelina/flowertypes.pdf.

Plate 1. Type 1 flowers, white and very pale blue.



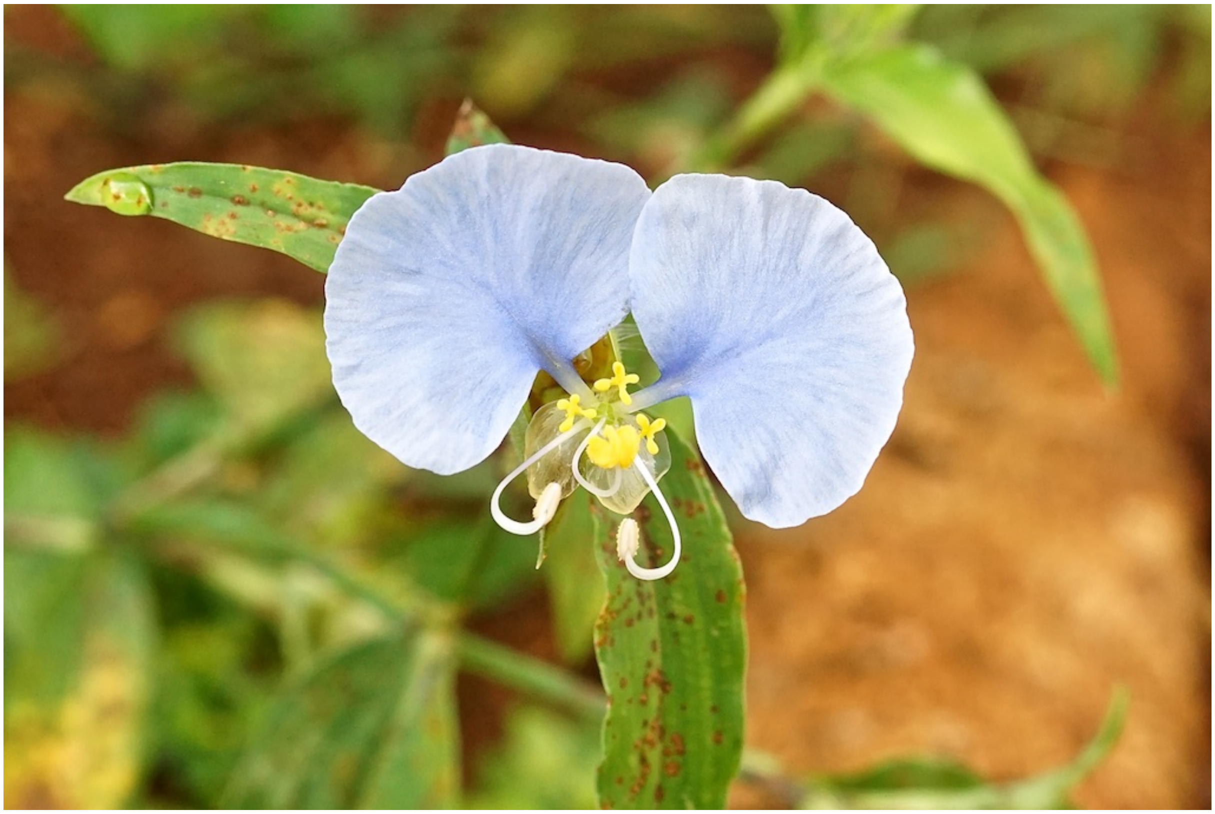
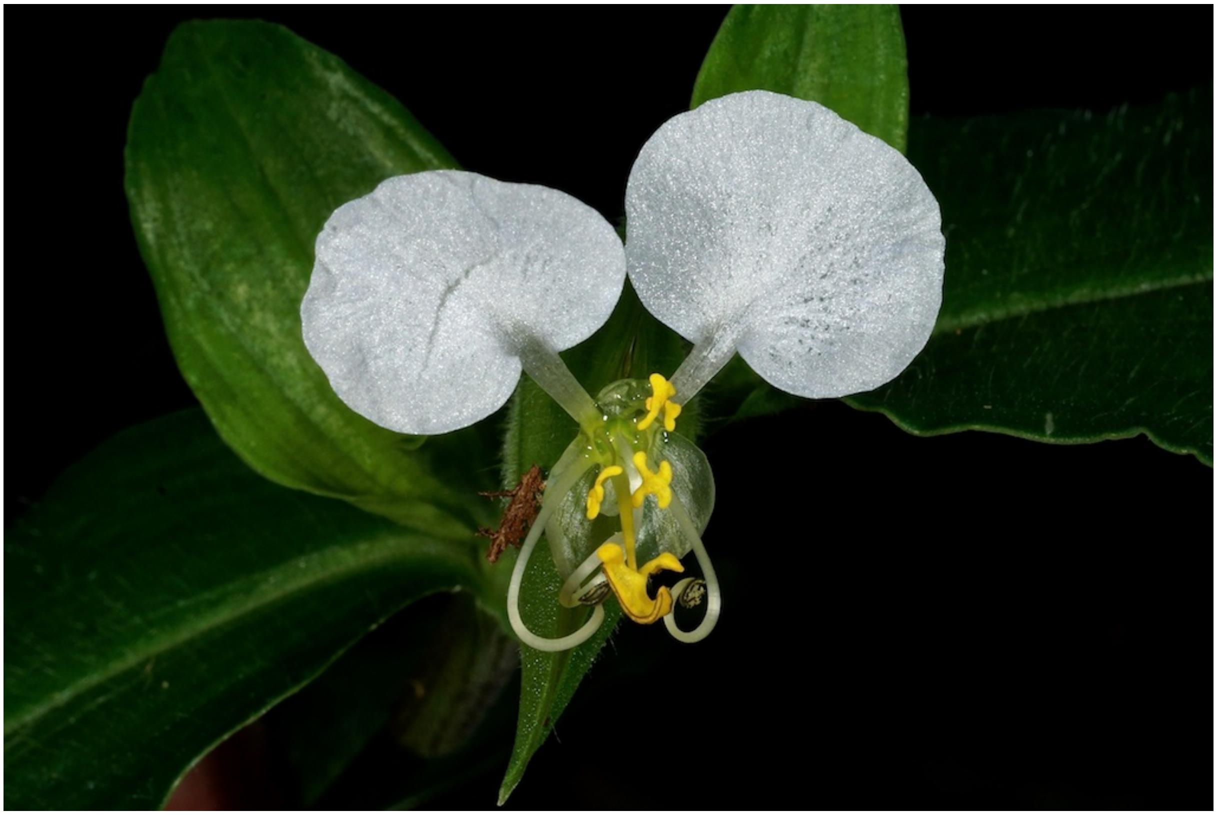


Plate 2. White type 3 flowers.



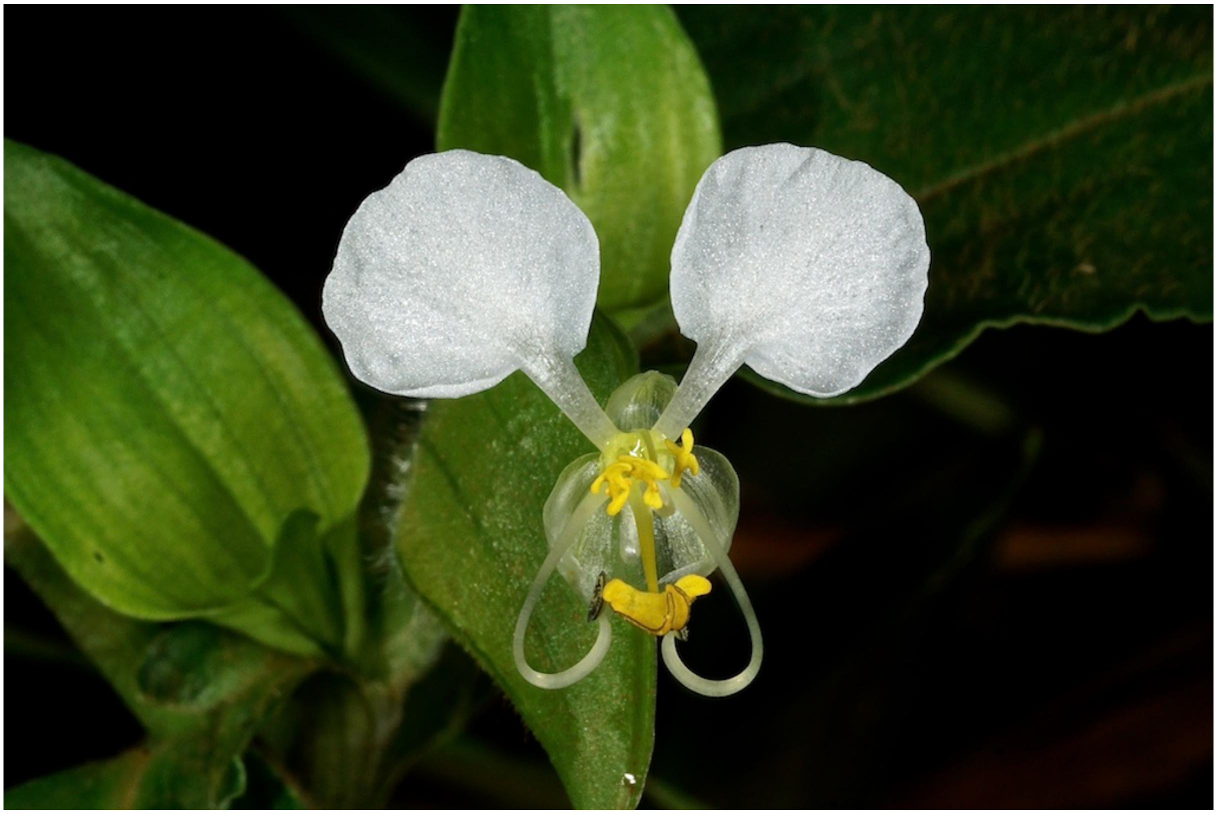
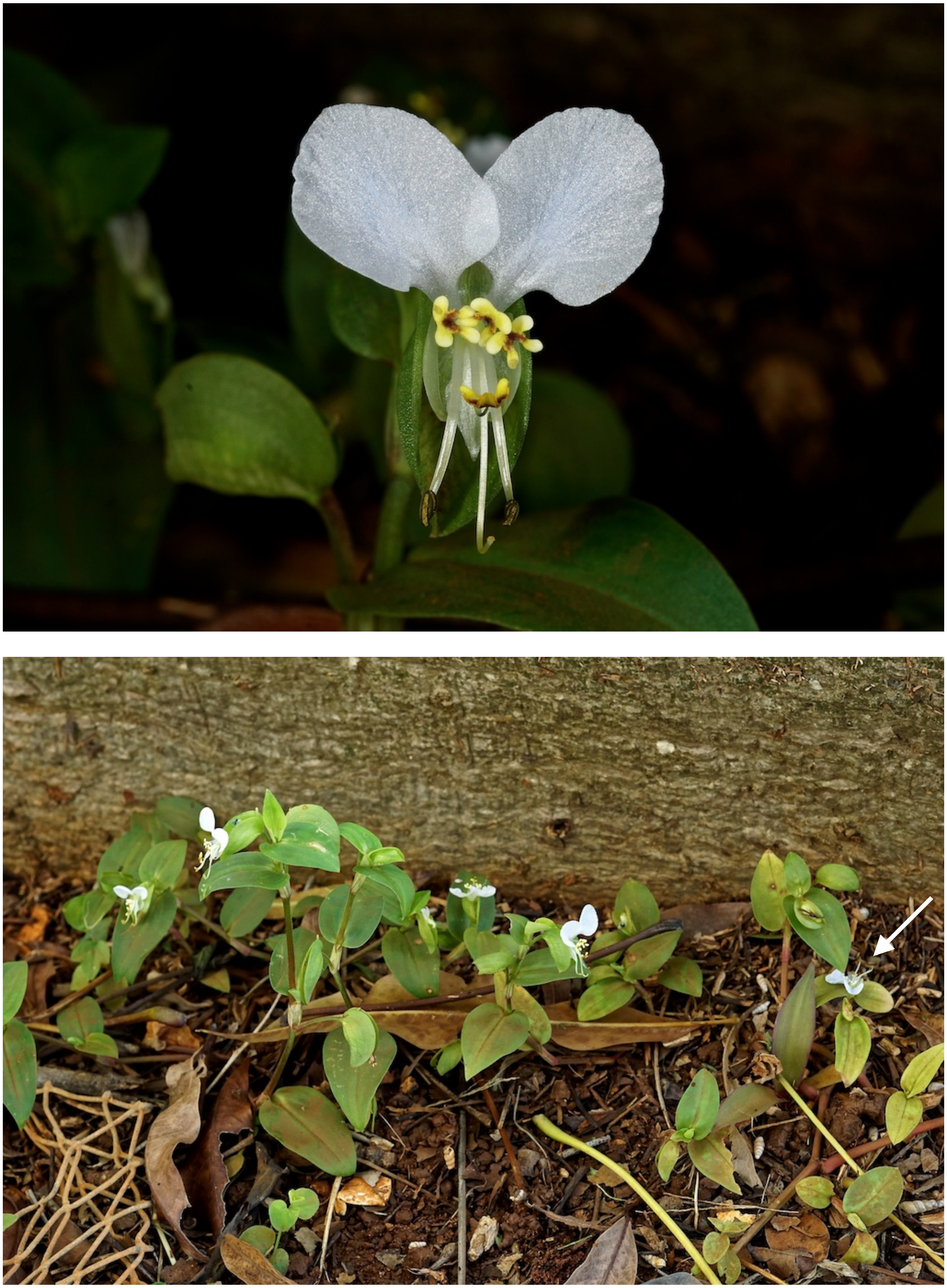


Plate 3. *Commelina communis* white flowers, note the presence of a pale blue flower on the second photo (arrow).



Notes on *Commelina* 6. Flowering times for four species under cultivation in Aguadilla, Puerto Rico

José A. Mari Mut

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On the cover- *Commelina erecta* type 1 at the author's garden, 9:25 a.m.

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URLs- http://edicionesdigitales.info/commelina/flowering.pdf. https://archive.org/details/flowering. Updated November 6, 2018.

Notes on *Commelina* 6. Flowering times for four species under cultivation in Aguadilla, Puerto Rico

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During several weeks in July and early August 2018, my daily morning walks were preceded and followed by short visits to the *Commelina* plants cultivated in my garden at Aguadilla (18.4648, -67.14846). Similar visits made right before leaving (~10 a.m.) and immediately after returning (~11 a.m.) from an early lunch indicated that different species and also different flower types of *C. erecta* (Mari Mut, 2018a) varied in their flower opening and closing times. To refine the observations, on August 28 I visited all the plants every 15 minutes from 5 a.m. until 1:00 p.m., when all the flowers had closed. The following table summarizes my observations.

Species	Opening began	All flowers fully open	Closing began	All flowers fully closed
C. erecta type 1	5:30 a.m.	6:30 a.m.	11:00 a.m.	12:00 m.
C. erecta type 2a	5:30 a.m.	6:30 a.m.	10:45 a.m.	12:00 m.
C. erecta type 3	5:00 a.m.	6:00 a.m.	9:15 a.m.	10:00 a.m.
C. erecta type 4	5:30 a.m.	6:30 a.m.	9:45 a.m.	11:00 a.m.
C. benghalensis	6:15 a.m.	7:30 a.m.	12:15 p.m.	12:45 p.m.
C. communis	6:15 a.m.	7:30 a.m.	11:30 a.m.	1:00 p.m.
C. diffusa	7:30 a.m.	8:15 a.m.	11:00 a.m.	12:00 m.

The first flowers to start opening (petals projected from the spathes but still furled) belonged to *C. erecta* type 3, they were also the first to close. Observations made on the following day revealed that these flowers can begin opening by 4:30 a.m. The last flowers to start opening belonged to *C. diffusa*, while the last to fully close belonged to *C. communis*.

Flowers of the four *C. erecta* types opened and closed at hours closer to one another than to the other species.

Flower opening and closing times may change depending on environmental factors (Van Doorn and Meeteren, 2003). In my garden, flowers of *C. benghalensis* and *C. diffusa* began closing soon after the plants were fully exposed to the sun. On a particularly warm morning, flowers of *C. erecta* types 3 and 4 had closed by 9 a.m.

Oziegbe et al. (2013) reported that two subspecies of *C. diffusa* in Nigeria opened their flowers around 7:30 and 8:00 a.m., and began closing them around 11 a.m., which is similar to the observations reported here. Two variants of *C. erecta* opened their flowers around 5:00 a.m. and closed them around 10:30 a.m., not far from my observations at Aguadilla.

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Notes on *Commelina* 7. Key to the Puerto Rican species

José A. Mari Mut

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On the cover- *Commelina erecta* type 1. All photographs by the author, except Fig. 12 (http://floraelverde.catec.upr.edu/especie_info.php?id=113).

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Notes on *Commelina* 7. Key to the Puerto Rican species

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My first and third notes about *Commelina* (Mari Mut, 2018a,b) reported the presence of five variants or types of *C. erecta* in northwest Puerto Rico; the following key distinguishes them, and also the other three species of the genus that grow naturally on the island. Originally from Asia, *C. benghalensis* was first collected in Cayey (Axelrod, 2011) and has since been observed in Caguas (Axelrod, pers. comm.) and Cidra (José D. Alicea, pers. comm.). The other three species are considered native, although Morton (1967) has suggested that *C. erecta* originated in tropical Africa.

1a. Auricles present (Fig. 1) …………………………………………………… 2
1b. Auricles absent (Fig. 2) …………………………………………………… 6

2a. Flowers blue (see cover) …………………………………………………… 3
2b. Flowers light blue (Fig. 3a) or white (Fig. 4a) ……………………………… 5

3a. Flowers large (up to ~40 mm wide); seeds large (~ 3.6 mm long), ovate, with an interrupted keel, lip or ridge (Fig. 5) ………………… *C. erecta* type 1
3b. Flowers small (up to ~20 mm wide); seeds small (~ 2.7 mm long), reniform, without a keel, lip or ridge (Fig. 6), or seeds absent ……………. 4

4a. Staminodes small, compact (Fig. 7); seeds present…. *C. erecta* type 2a
4b. Staminodes larger, with bigger lobes (Fig. 8); seeds apparently absent (not yet found?) ……………………………………………*C. erecta* type 2b

5a. Flowers light blue (Fig. 3a); upper and lower staminode lobes similar (Fig. 3b), central staminode sometimes transformed partly or completely into a petal ……………………………………………….. *C. erecta* type 3
5b. Flowers white (Fig. 4a); upper staminode lobes thicker (Fig. 4b), central staminode never transformed into a petal ………………… *C. erecta* type 4

6a. Leaves ovate, not sharply pointed (Fig. 9) ……….…..… *C. benghalensis*
6b. Leaves lanceolate, sharply pointed (Fig. 10) ……….……………..….….… 7

7a. Flowers blue (Fig. 11); leaves up to 8 cm long; found in altered habitats throughout the island ………………...……….………….. *C. diffusa* var. diffusa
7b. Flowers white (Fig. 12); leaves up to 17 cm long; found mostly in wet montane habitats ……….…..……………….….…… *C. rufipes* var. *glabrata*

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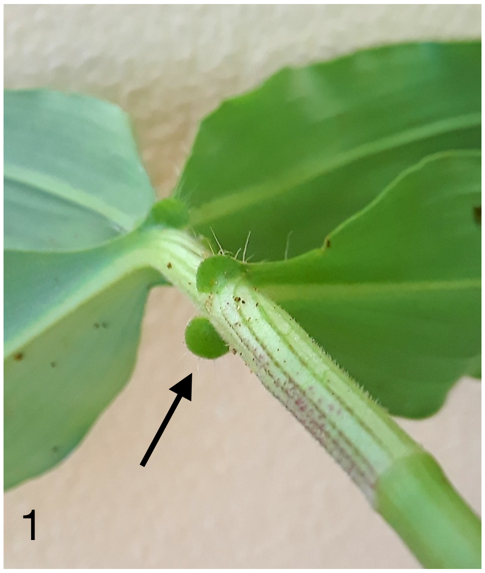
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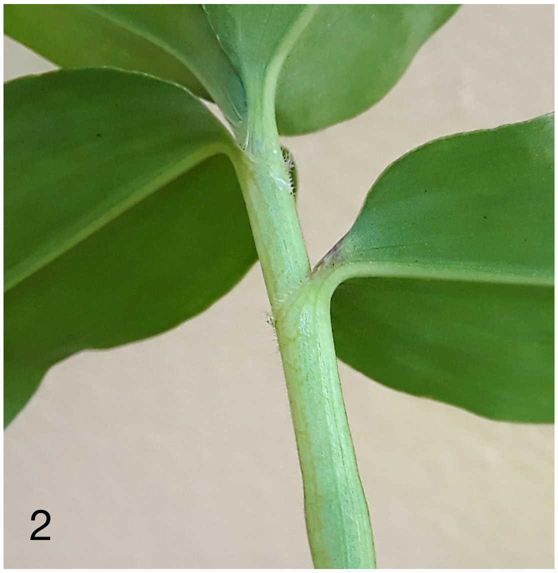
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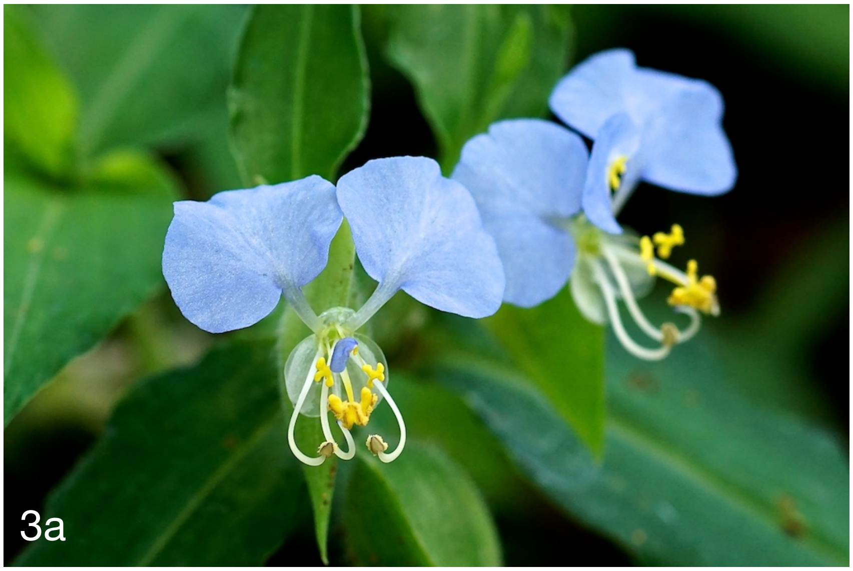
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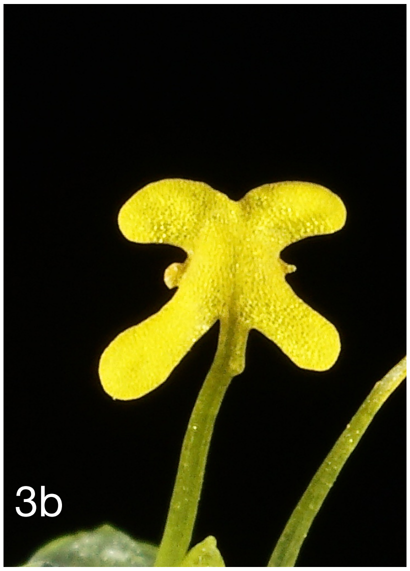
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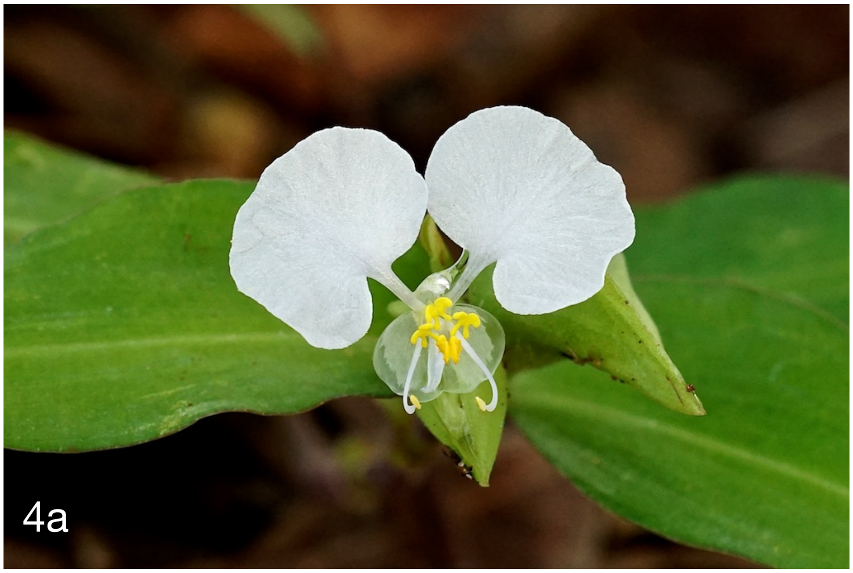
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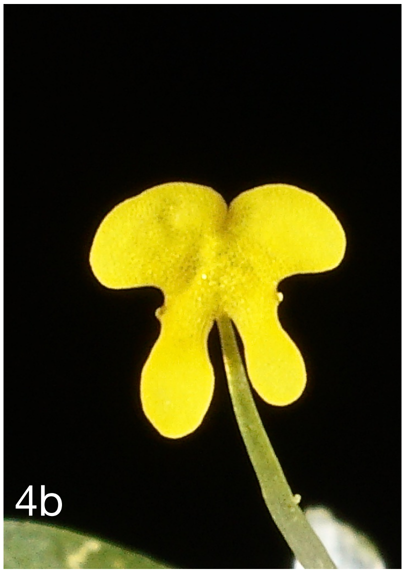
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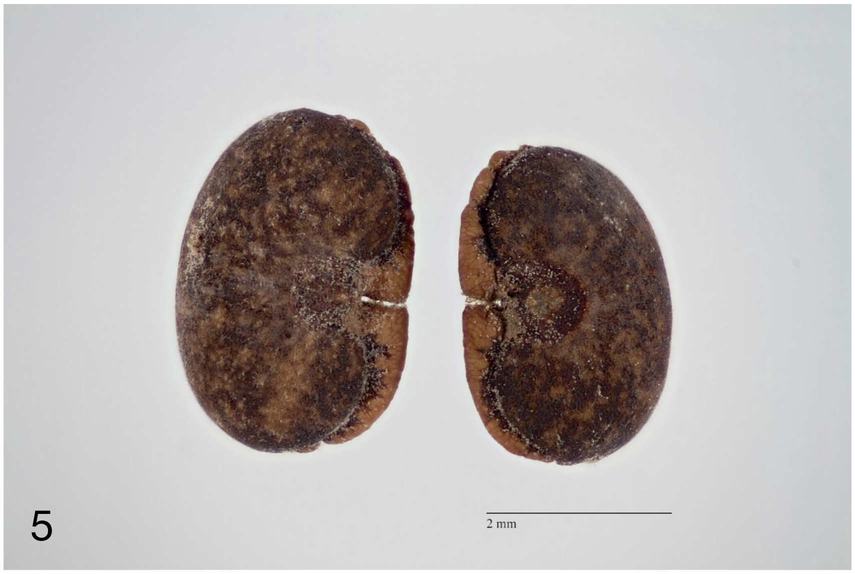
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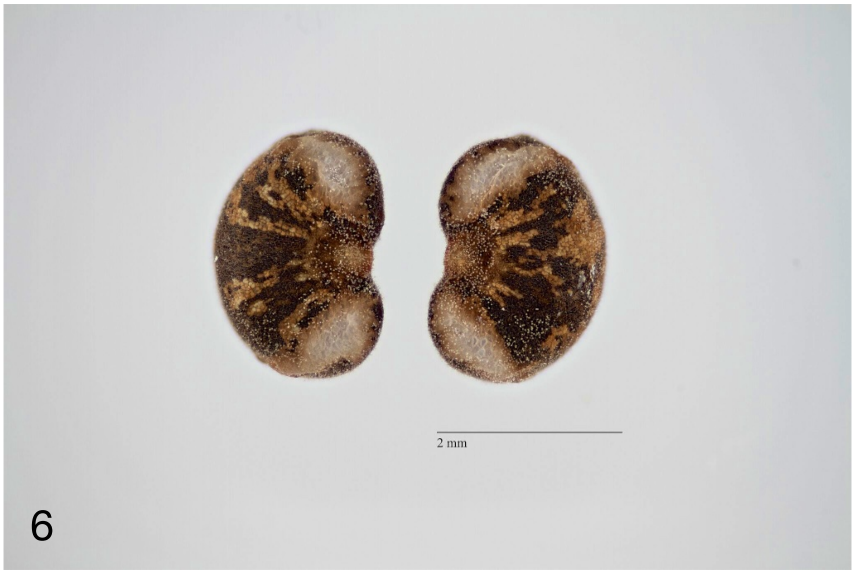
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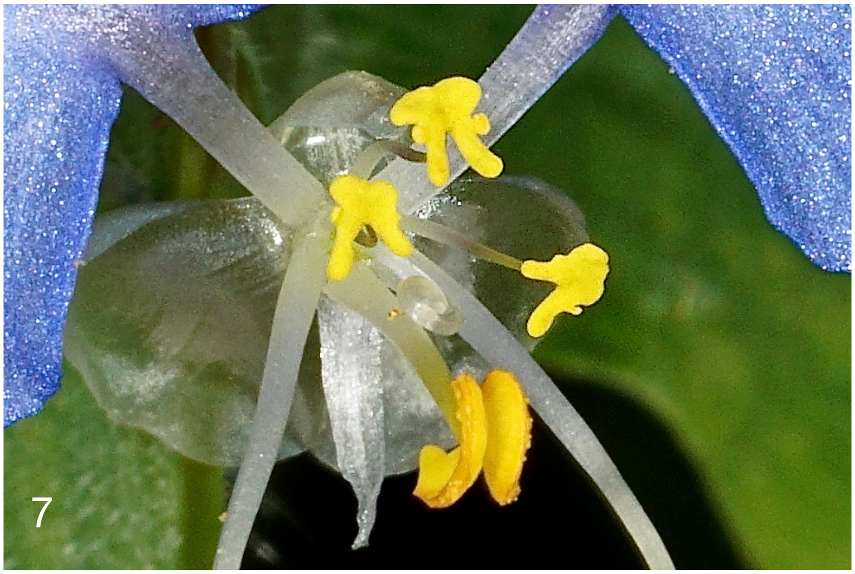
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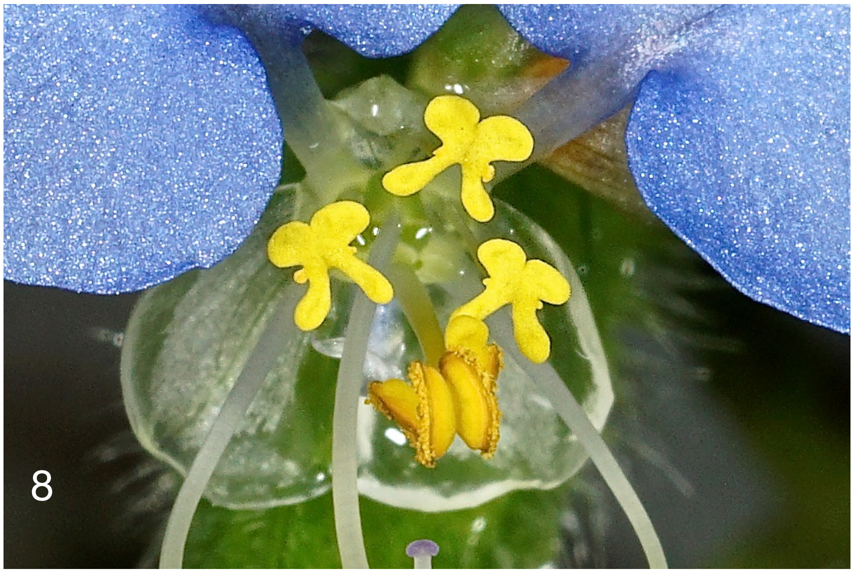
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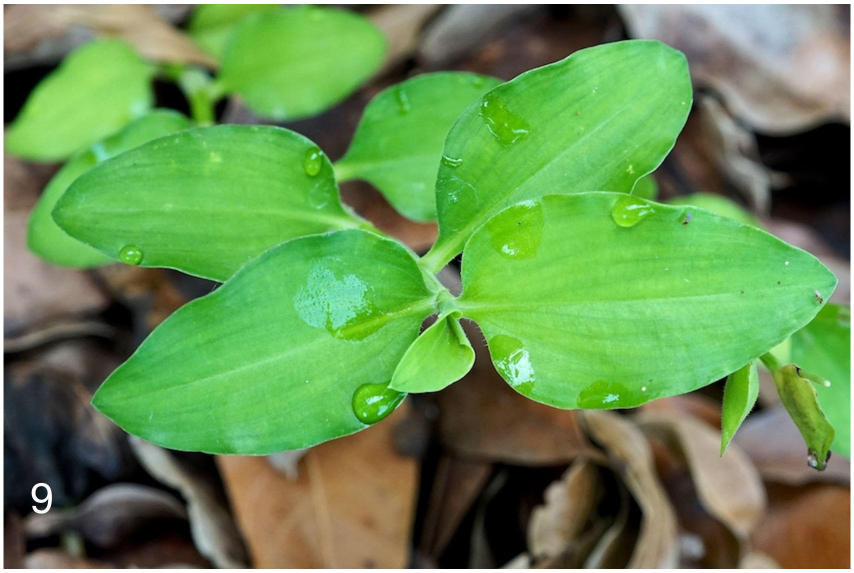
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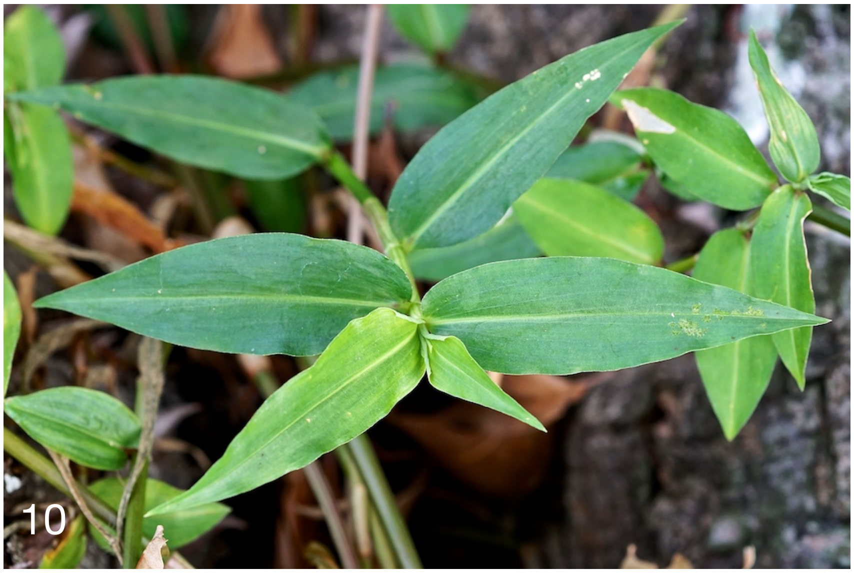
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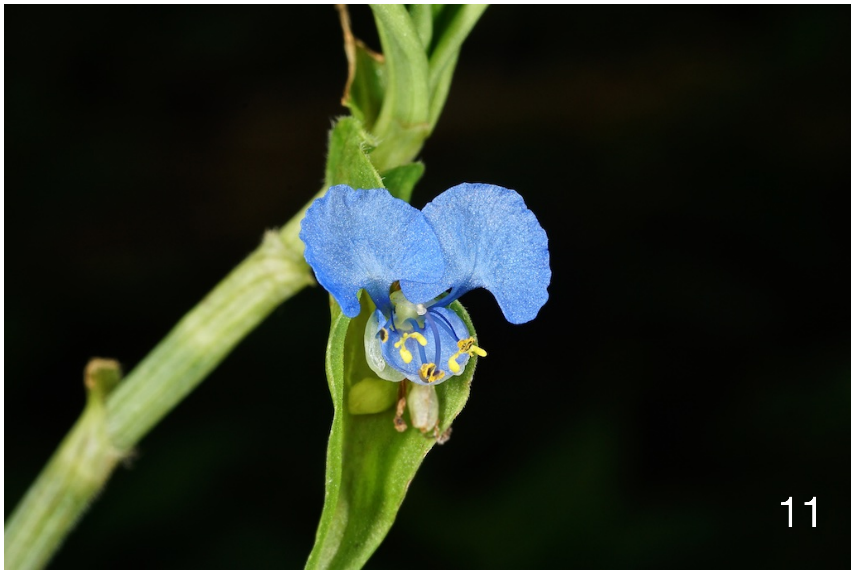

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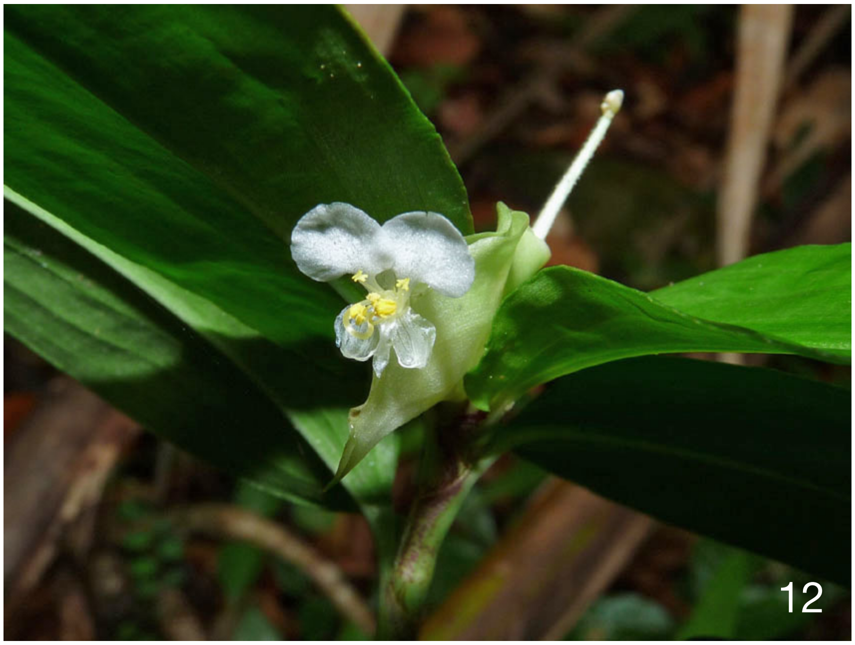

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